

Amateur Radio on the International Space Station (ARISS) PRESENTATION

Charlie Sufana AJ9N • aj9n@aol.com

Radio Amateur Training Planning and Activities Committee

RATPAC • ratpac.plan@gmail.com

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Welcome!
Are you ready for a fun
ride?

Today's topics

Presented by Charlie Sufana AJ9N

One of the ARISS mentors

- What is ARISS?
- Comments on packet and general voice operation
- Antenna setup locations
- Happy students; schools from around the world
- The application, pre-contact, contact, and post-contact process
- Video of ARISS school contact
- Your questions

Amateur Radio on the International Space Station (ARISS)



ARISS *Overview Package*

Frank H. Bauer, ka3hdo@amsat.org, AMSAT
Rosalie White, k1sto@arrl.org, ARRL

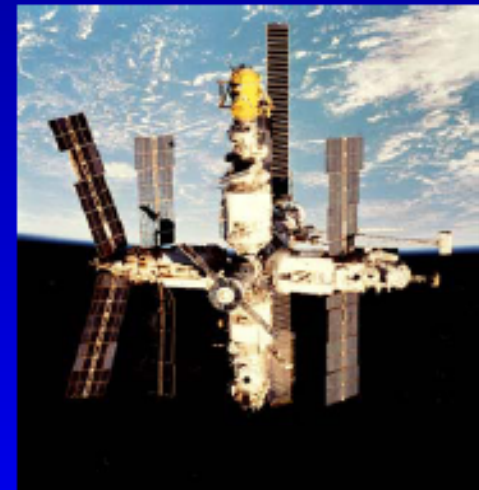
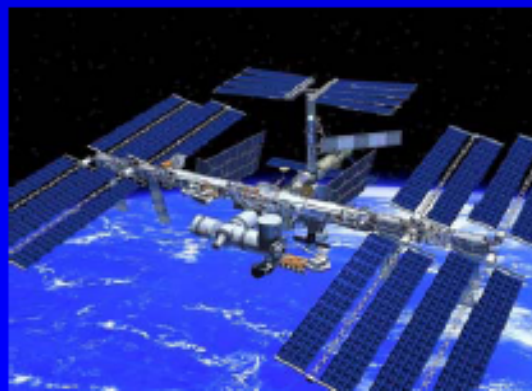
Amateur Radio on Human Spaceflight Missions

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:



Space Shuttle

ISS



Mir

ARISS Objectives



Spark Student's Interest
In Science & Technology



Crew Family Contacts
(Crew Psychological Ops)



Promote Interest
In Amateur Radio

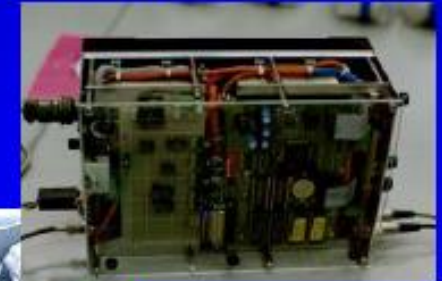


Human Spaceflight
Awareness



Mn SSTV
Dec 12 99 17:29 UTC Rec W8ZCF

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
- Rules & Bylaws developed with delegates from Europe (4), America (4), Russia (2) and Japan (2)



Planned Capabilities for Initial Station ISS Ham Phase 1



2-way voice

Planned Capabilities for Initial Station ISS Ham Phase 1 (Continued)

Posted : 06/28/97 17:58

To : ALL

From : R0MIR

Subject: Mir Status

Computer-to- Computer Radio Links

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 Spektr 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
E-mail from Mike
Foale after Progress
collision with Mir
Spektr Module**

Planned Capabilities for Initial Station

ISS Ham Phase 2

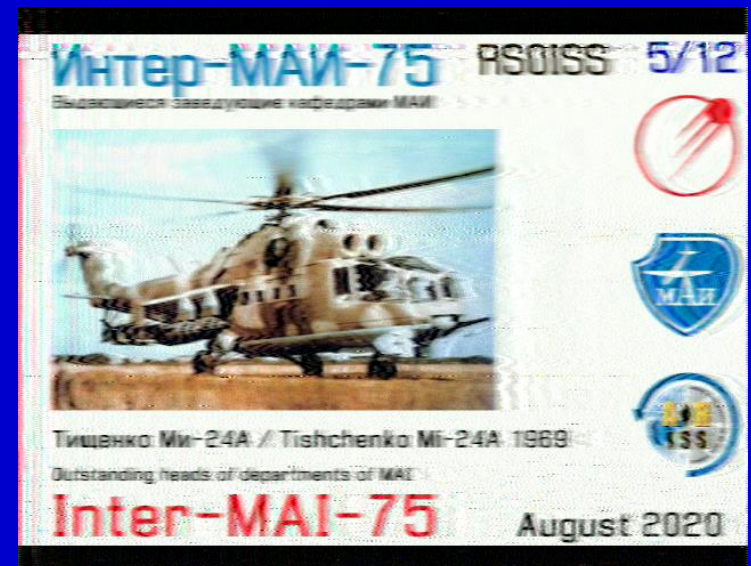


DigiTalker
(Voice Repeater)

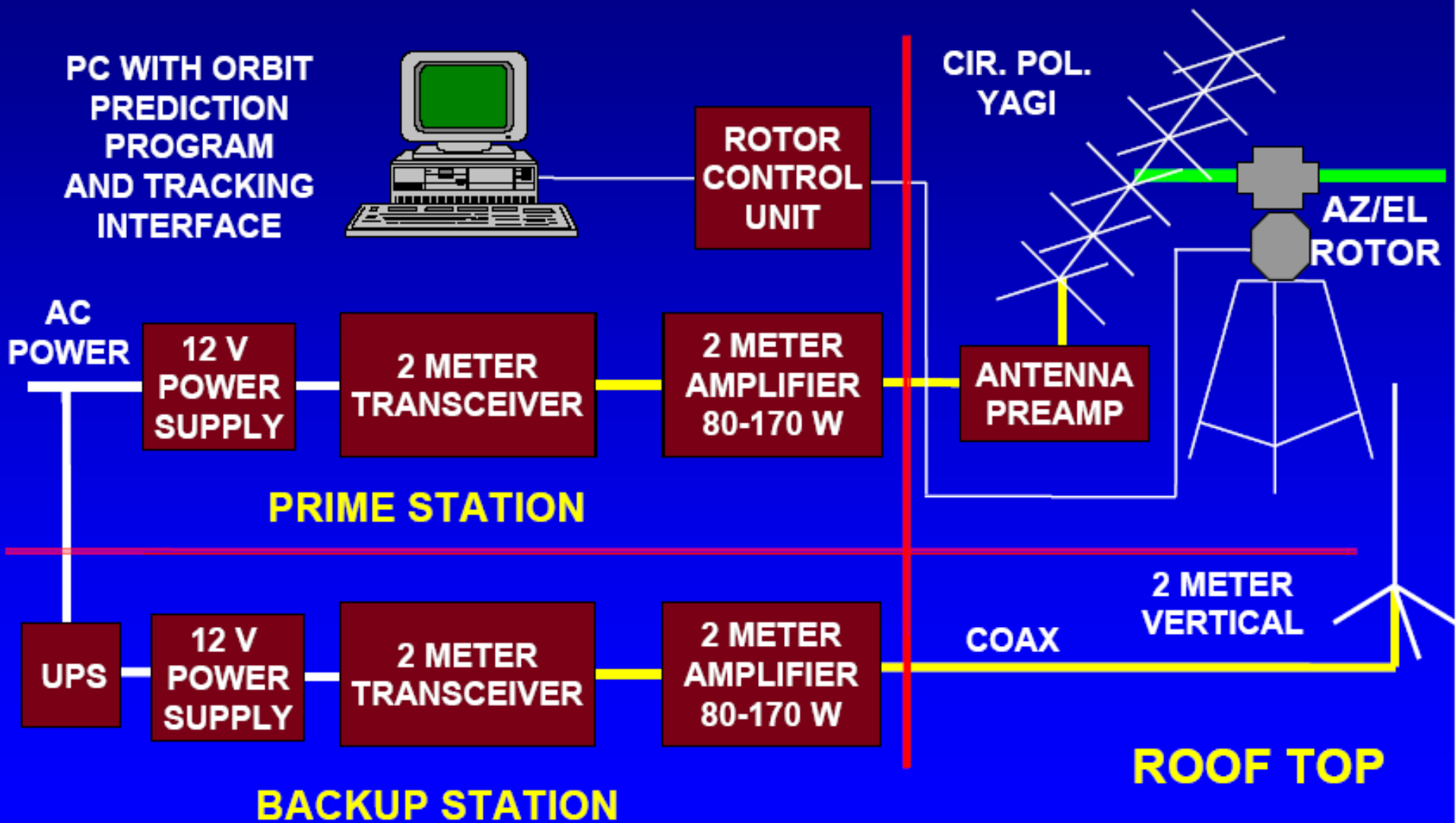


Slow Scan TV
(Photos/JPEG Images)

Recent SSTV pictures that I have received from the ISS using a Handheld HT and Robot36 app on a cell phone



DIRECT CONTACT INSTALLATION



General Contact Operations

Downlink:

-Worldwide both voice
& packet: 145.80

Uplink:

-Packet 145.99
-Voice:

-Region 1 (Europe & Africa) 145.20

Region 2 & 3 (Americas, Asia, Australia) 144.49

Crossband repeater: 437.8 down/145.99 up (67Hz)

Note: Packet lately has been on 145.825 Simplex

Callsigns:

-DPØISS

-IRØISS

-NA1SS

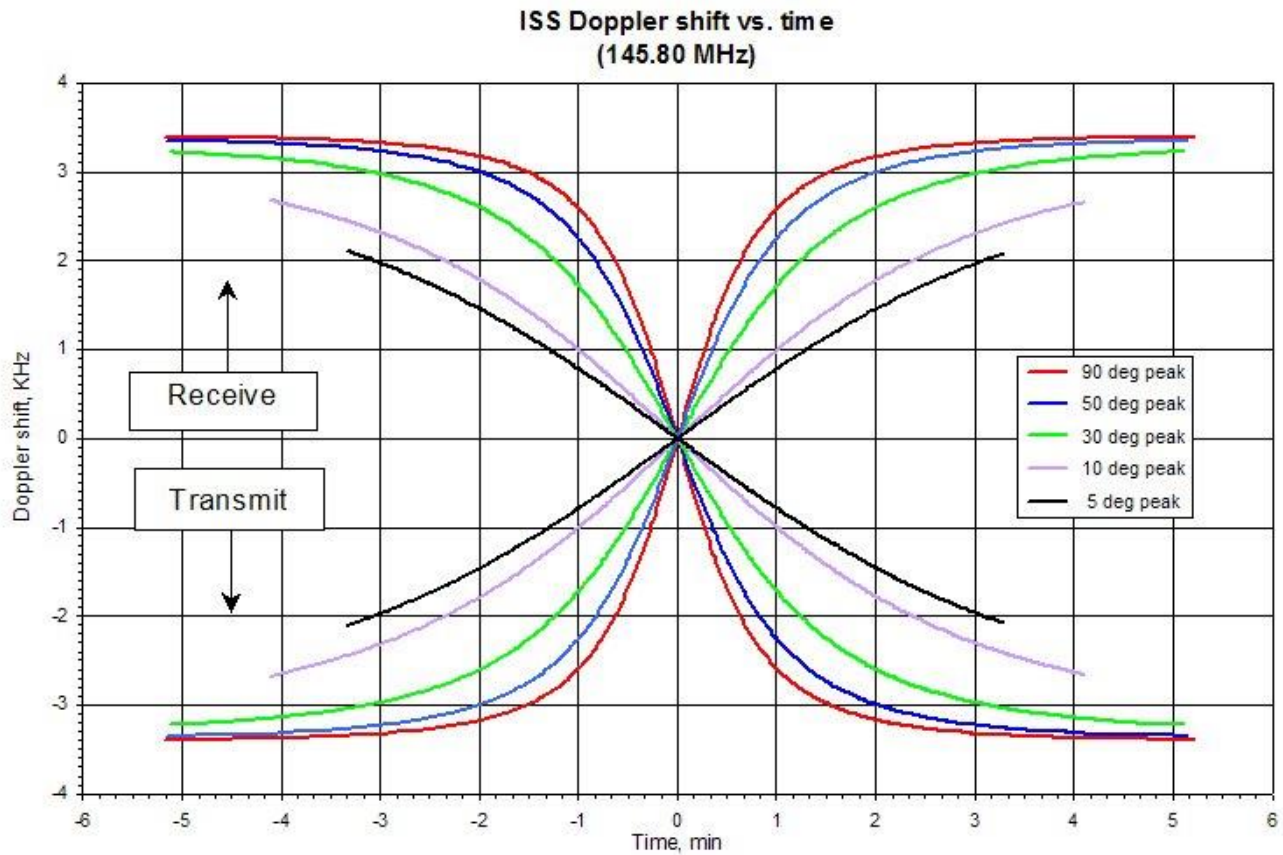
-OR4ISS

-RSØISS

Doppler shift for public voice frequencies

Transmit and receive frequencies for ISS ISS can not do Doppler correction							
	ISS downlink		ISS uplink				
Voice	145.800	Mhz	144.490	Mhz			
Regions 2 and 3 (US and Canada)							
Memory location if better than 5kHz steps	Doppler Khz	ISS transmits down		We listen at		We transmit at	ISS listens at
1	3	145.8000		145.8030		144.4870	144.4900
2	2	145.8000		145.8020		144.4880	144.4900
3	1	145.8000		145.8010		144.4890	144.4900
4	0	145.8000		145.8000		144.4900	144.4900
5	-1	145.8000		145.7990		144.4910	144.4900
6	-2	145.8000		145.7980		144.4920	144.4900
7	-3	145.8000		145.7970		144.4930	144.4900

Typical Doppler shift for the downlink frequency for various max elevations versus time are shown below.



Cross band repeater mode

Sometimes the crossband voice repeater on the ISS is turned on. **HAS BEEN VERY ACTIVE LATELY. TRY IT OUT!** There is a new Kenwood TM-D710GA on board.

Downlink frequency is 437.80 MHz

Uplink frequency is 145.99 MHz with 67 Hz tone

You will probably need to correct for Doppler shift! At 70cm it is about +/- 10 kHz; at 2m it is about +/-3.5 kHz

Packet operation

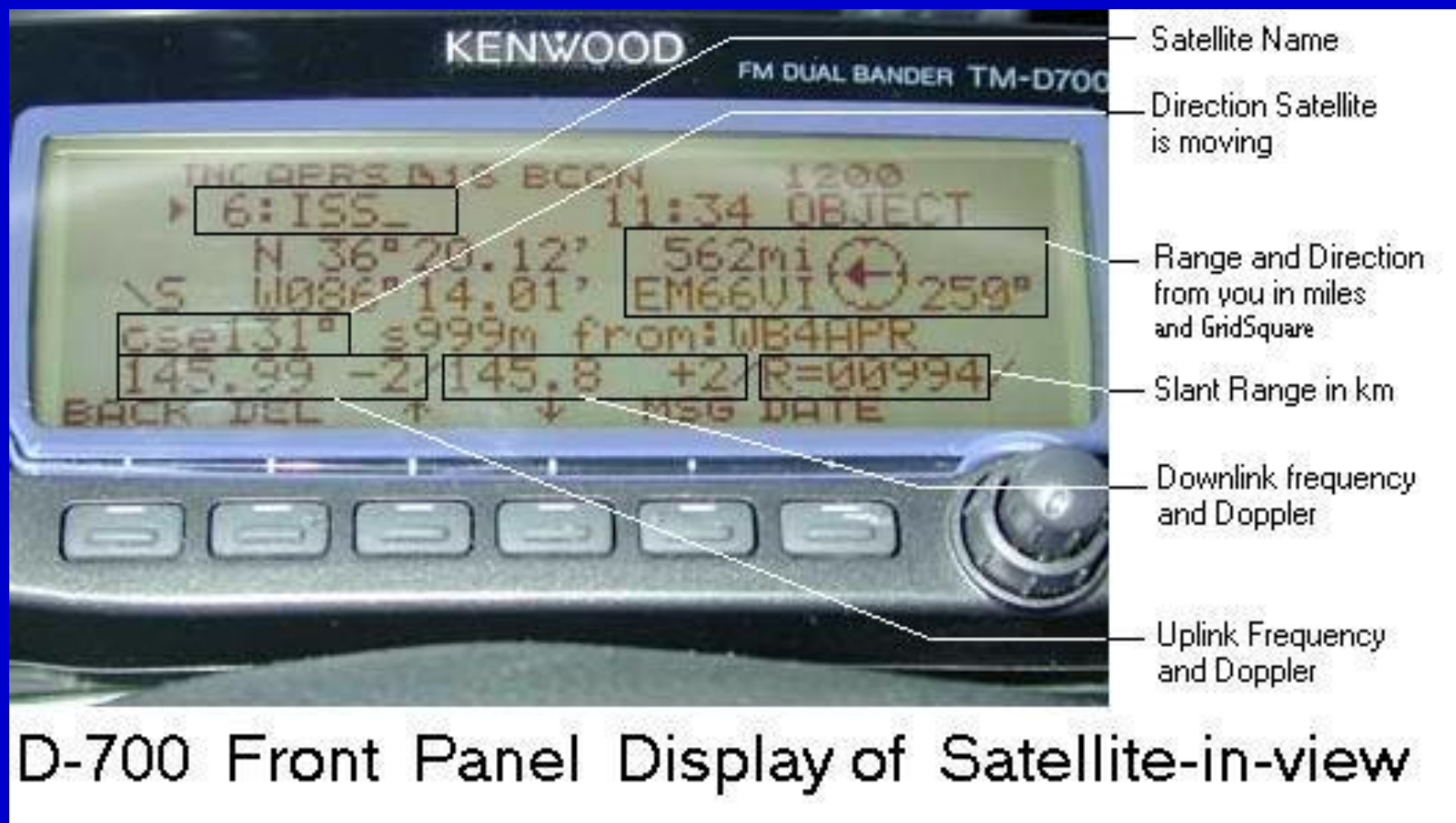
- ISS is now digipeating packets via the UNPROTO call of ARISS.
Old Uplink is 145.99 and old downlink is 145.80; they might still be used occasionally.
- Lately packet has been on 145.825
Simplex
- Packet radio is a communications method allowing a computer to computer connection.

D-700 radio

Used for packet, cross band
repeater, voice contacts



D-700 radio when in packet mode



NEW KENWOOD TM-D710GA



Launched on SpaceX-20 March 6, 2020 Installed September 2, 2020

Direct or Telebridge?

- Direct contacts are those that have the equipment at the school
- Telebridge contacts make use of the conference call facilities with a phone hookup to one of the ARISS ham ground stations

ARISS Telebridge Network

- AB1OC New Hampshire USA
- IK1SLD Italy
- K6DUE Maryland USA
- LU1CGB Argentina
- LU8YY Argentina
- ON4ISS Belgium
- VK4ISS Australia
- VK4KHZ Australia
- VK5ZAI Australia
- VK6MJ Australia
- W6SRJ California USA
- W5RRR Texas USA
- WH6PN Hawaii USA
- ZS6JON South Africa

ARISS Telebridge Network



Backup control operator Sam at telebridge station VK5ZAI



Backup control operators Sam (all grown up) and Magpie at telebridge station VK5ZAI



Backup control
operator Missy at
telebridge station
VK5ZAI ready for
action



All done after an ARISS contact,
time to relax



Hawaii telebridge station WH6PN AH6NM



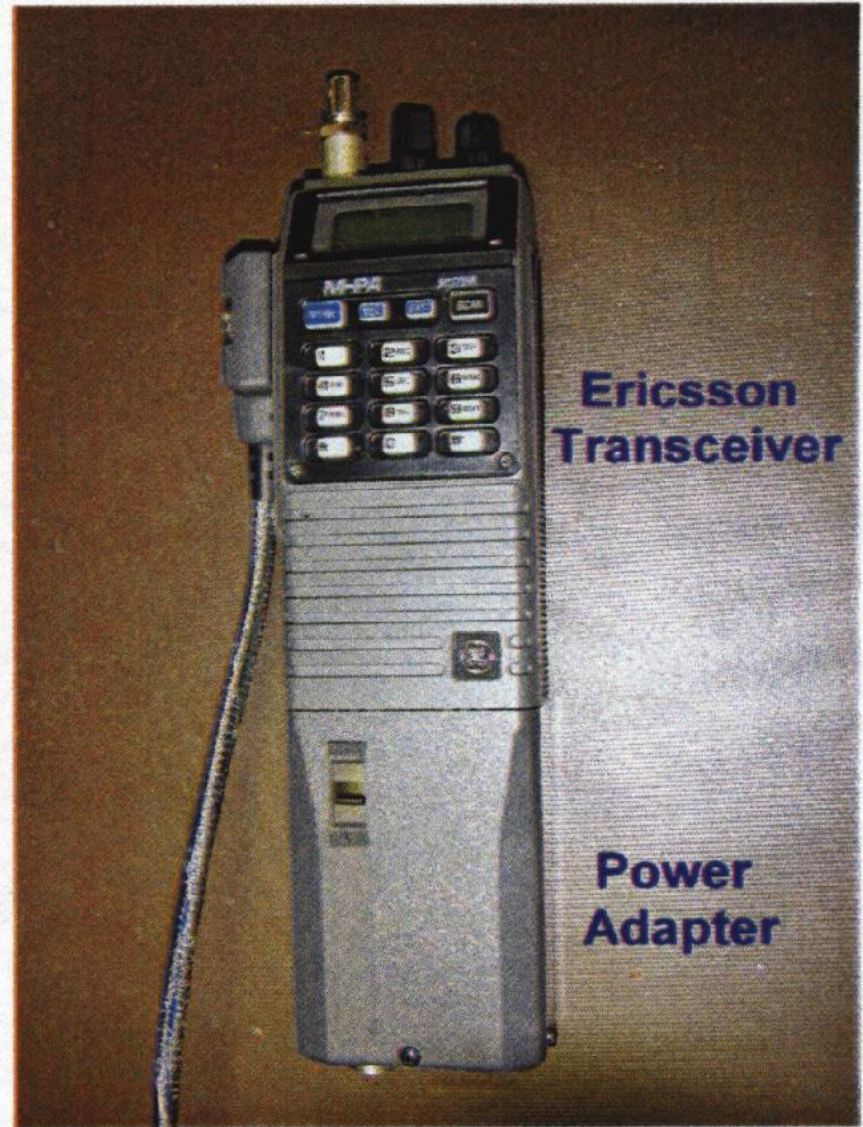
ARISS Information (Including School Group Proposals)

The new ARISS webpage is at

<http://www.ariss.org>



ARISS radio



Transceiver & Power Adapter

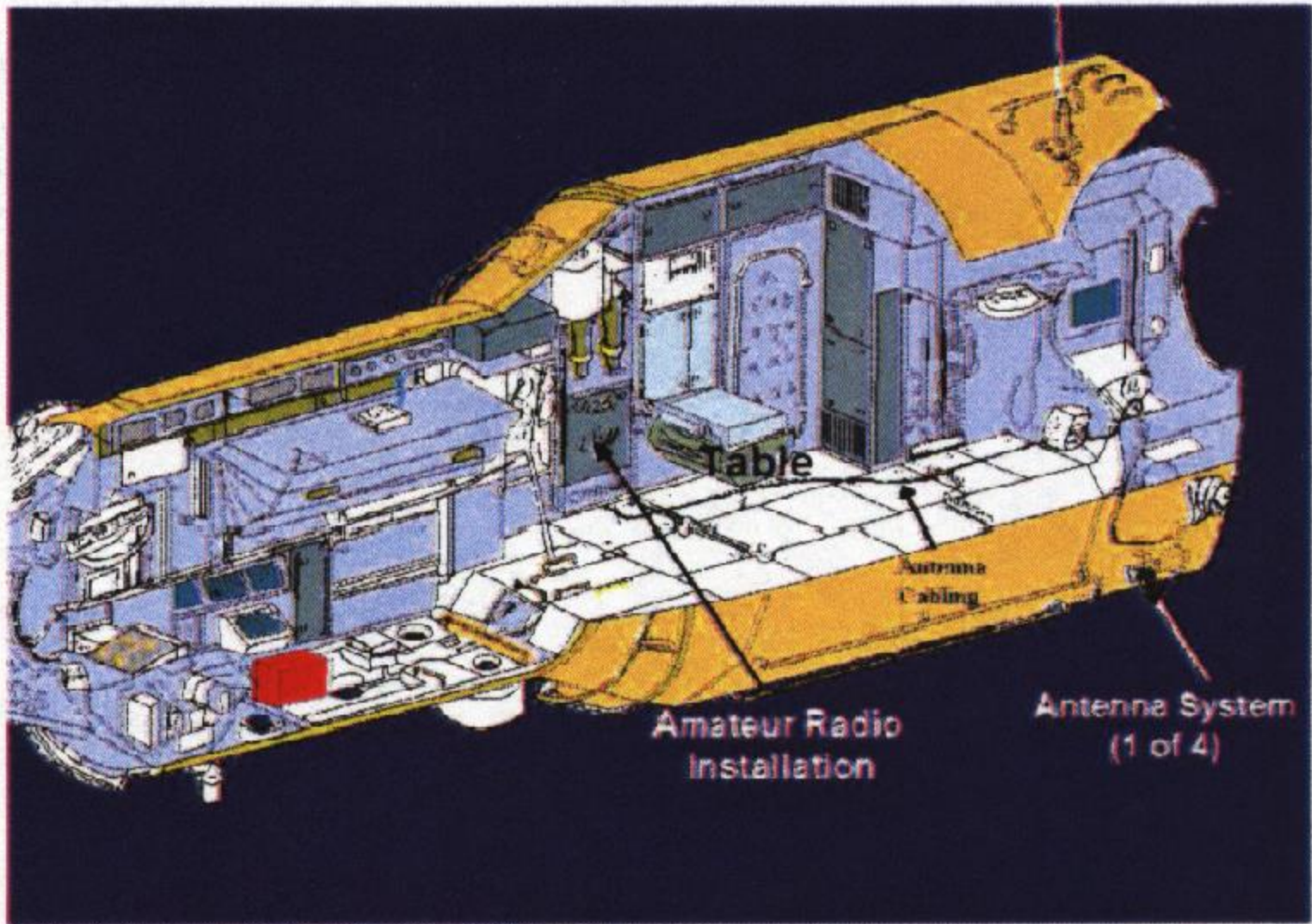
Ultra-Compact HF/VHF/UHF Transceiver

FT-100D

MICRO MOBILE

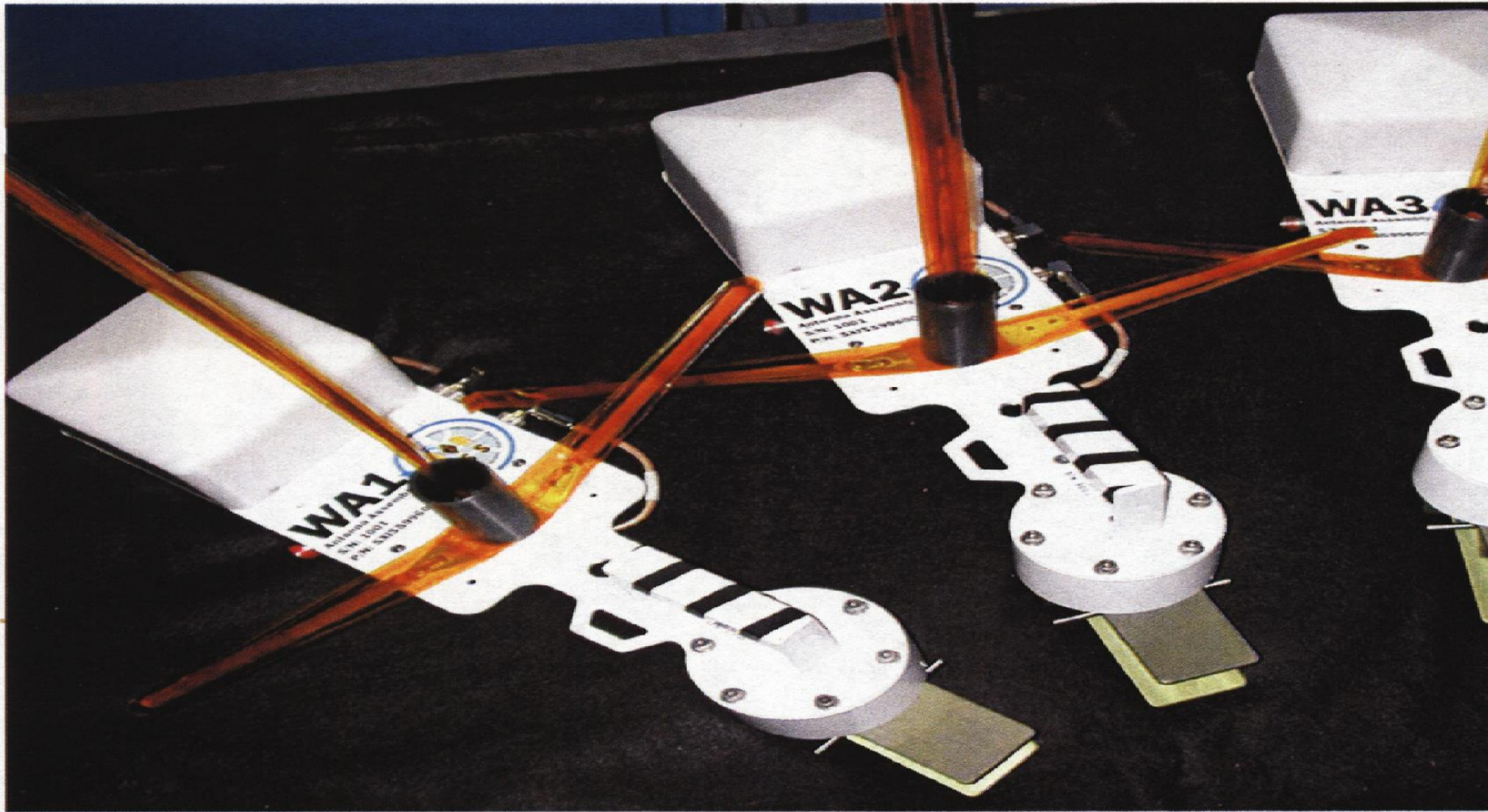


 **YAESU**
CLASS OF THE BATTERY TOP ANTENNA™



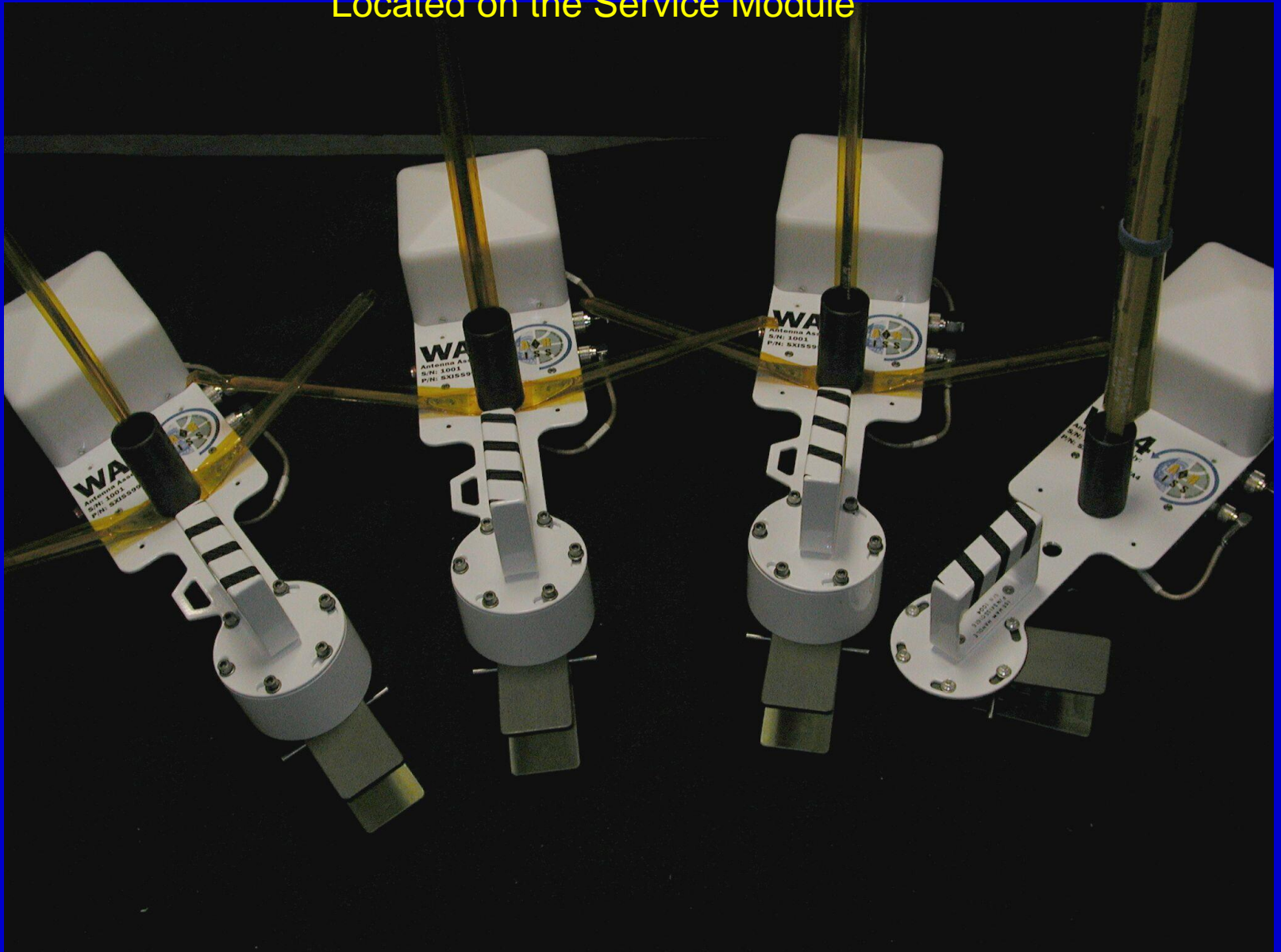
ISS Ham Hardware Location in
Service Module

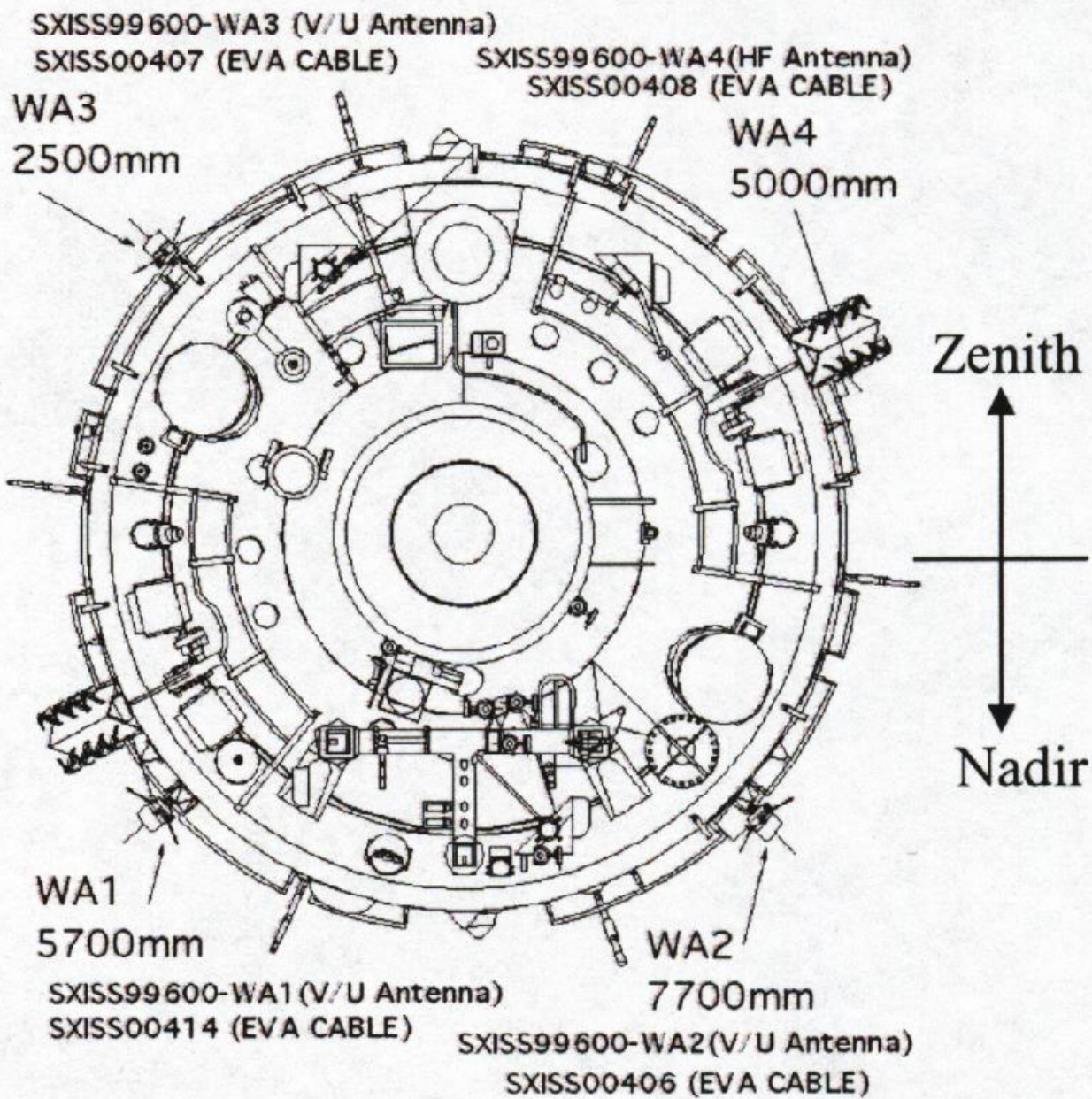
ARISS antennas



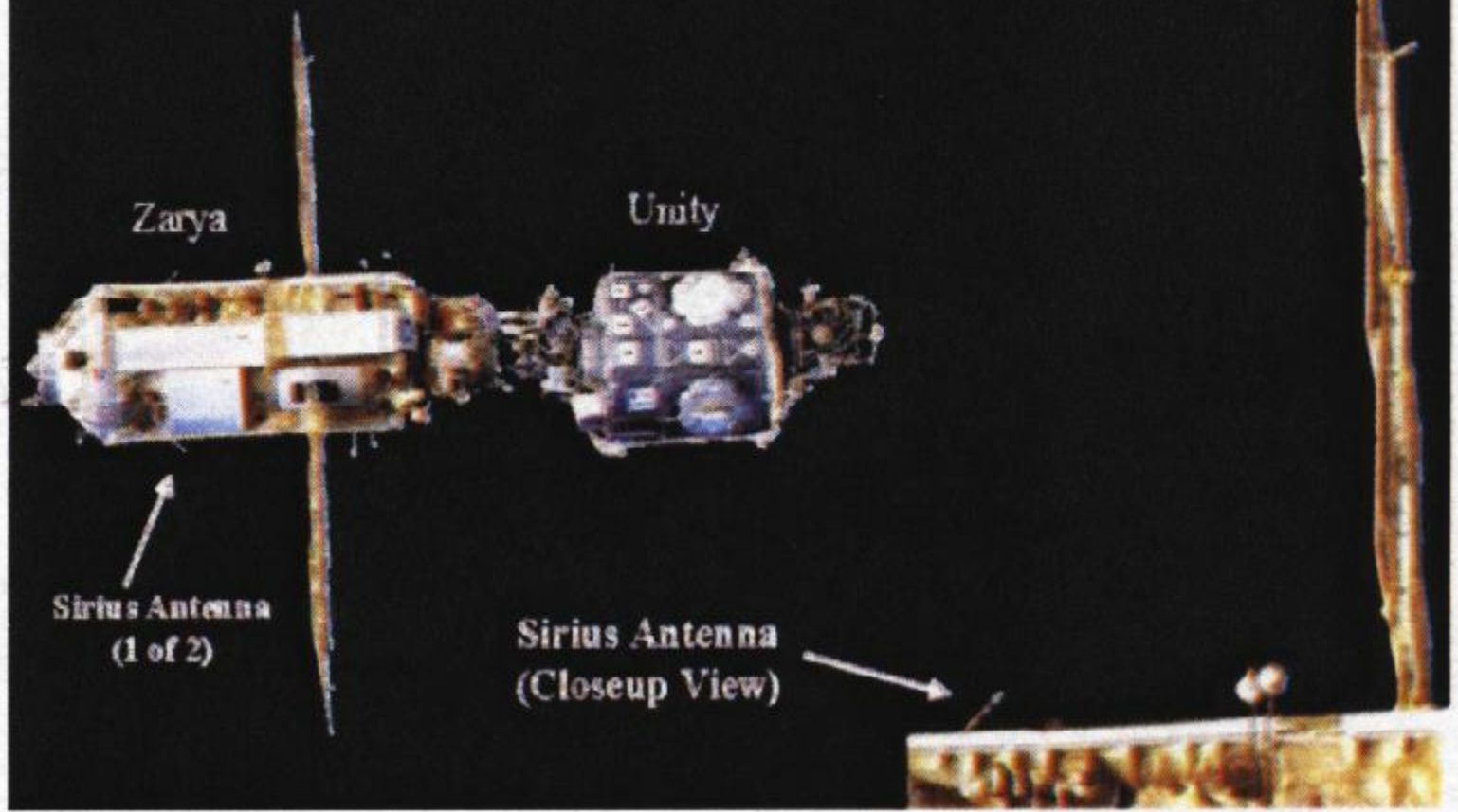
Antenna Systems WA1-WA4

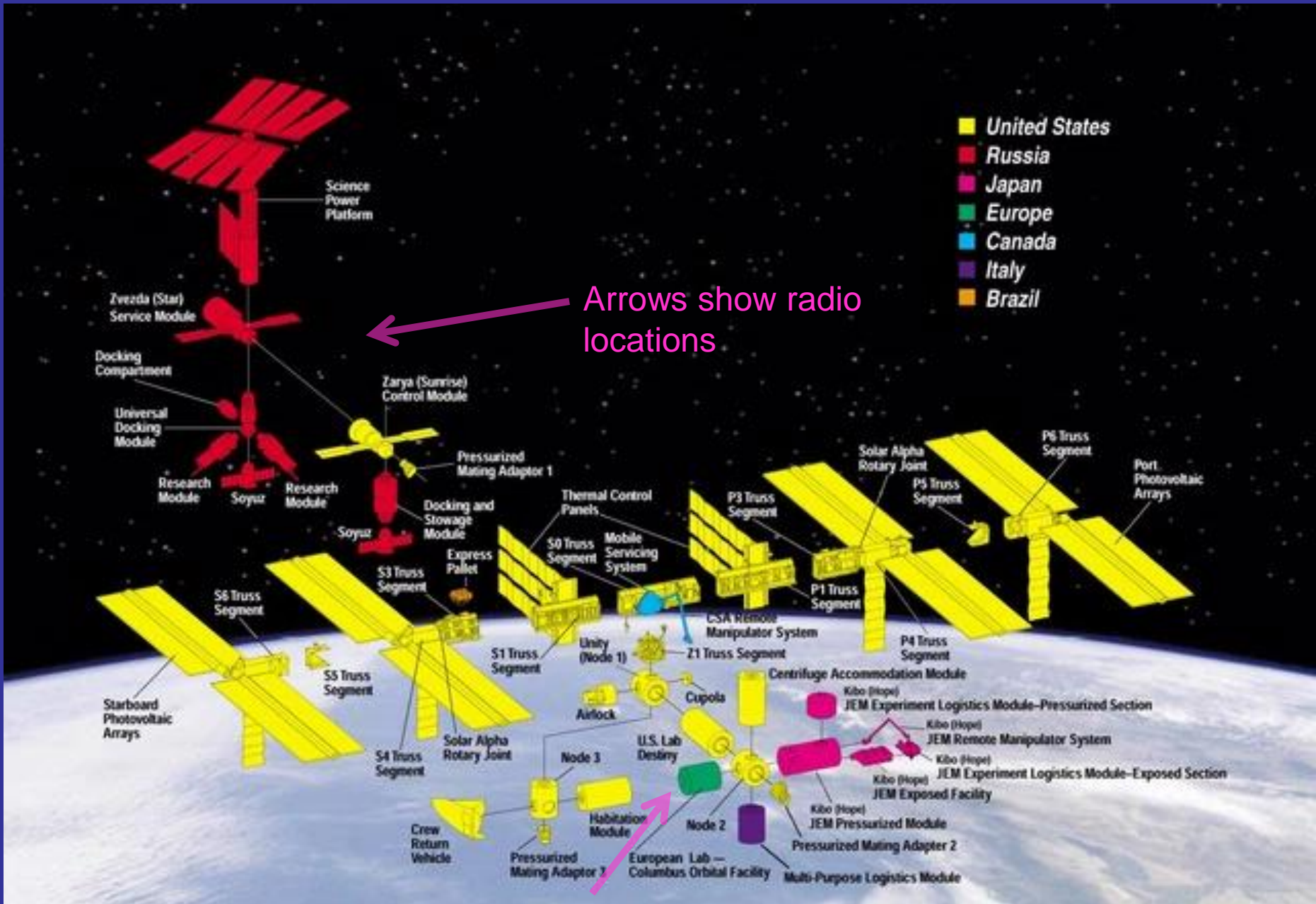
WA1, 2, 3 have 2m, 70cm, S and L band WA4 has 10m
Located on the Service Module





SIRIUS ANTENNA LOCATION ON ZARYA



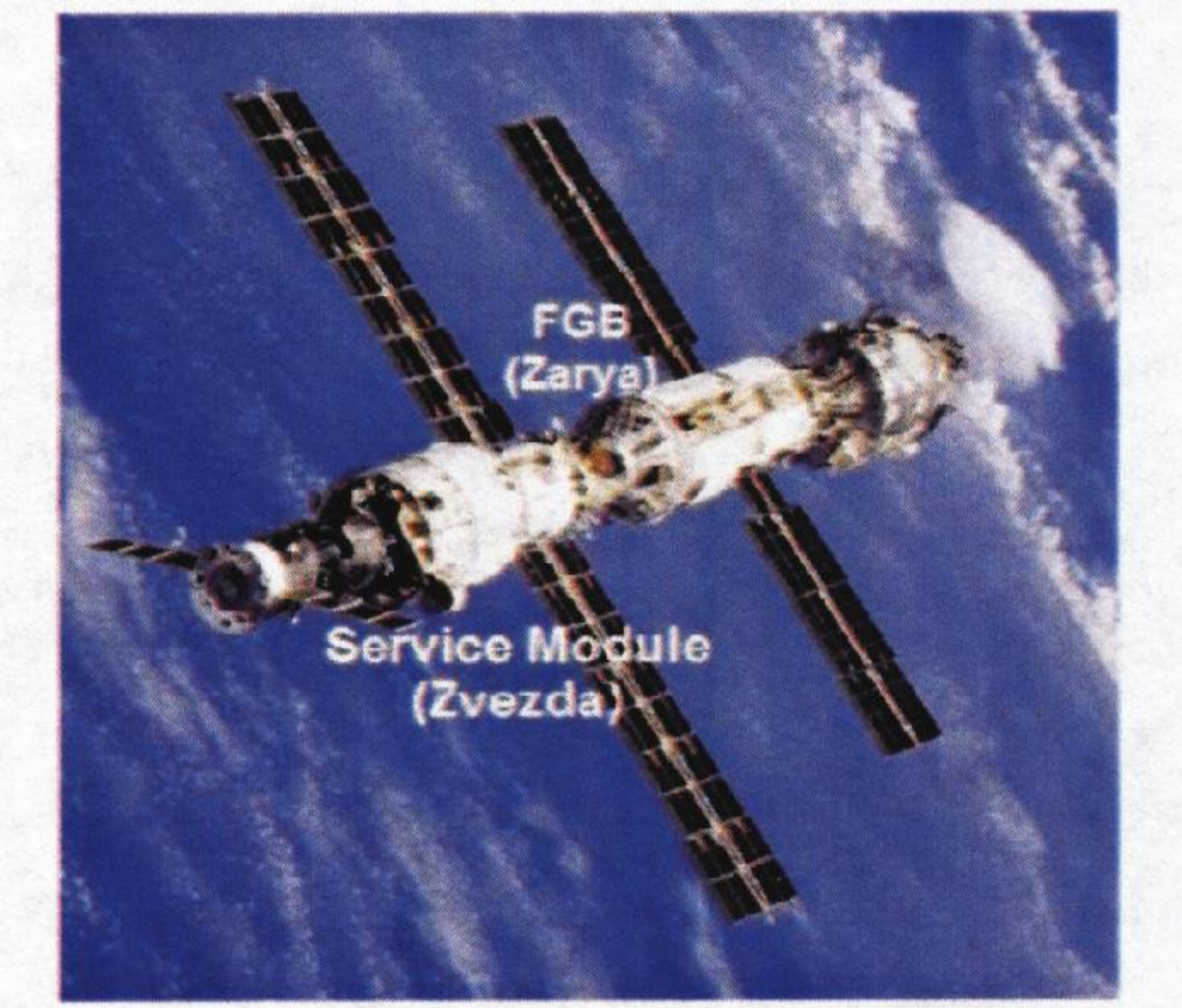


- United States
- Russia
- Japan
- Europe
- Canada
- Italy
- Brazil

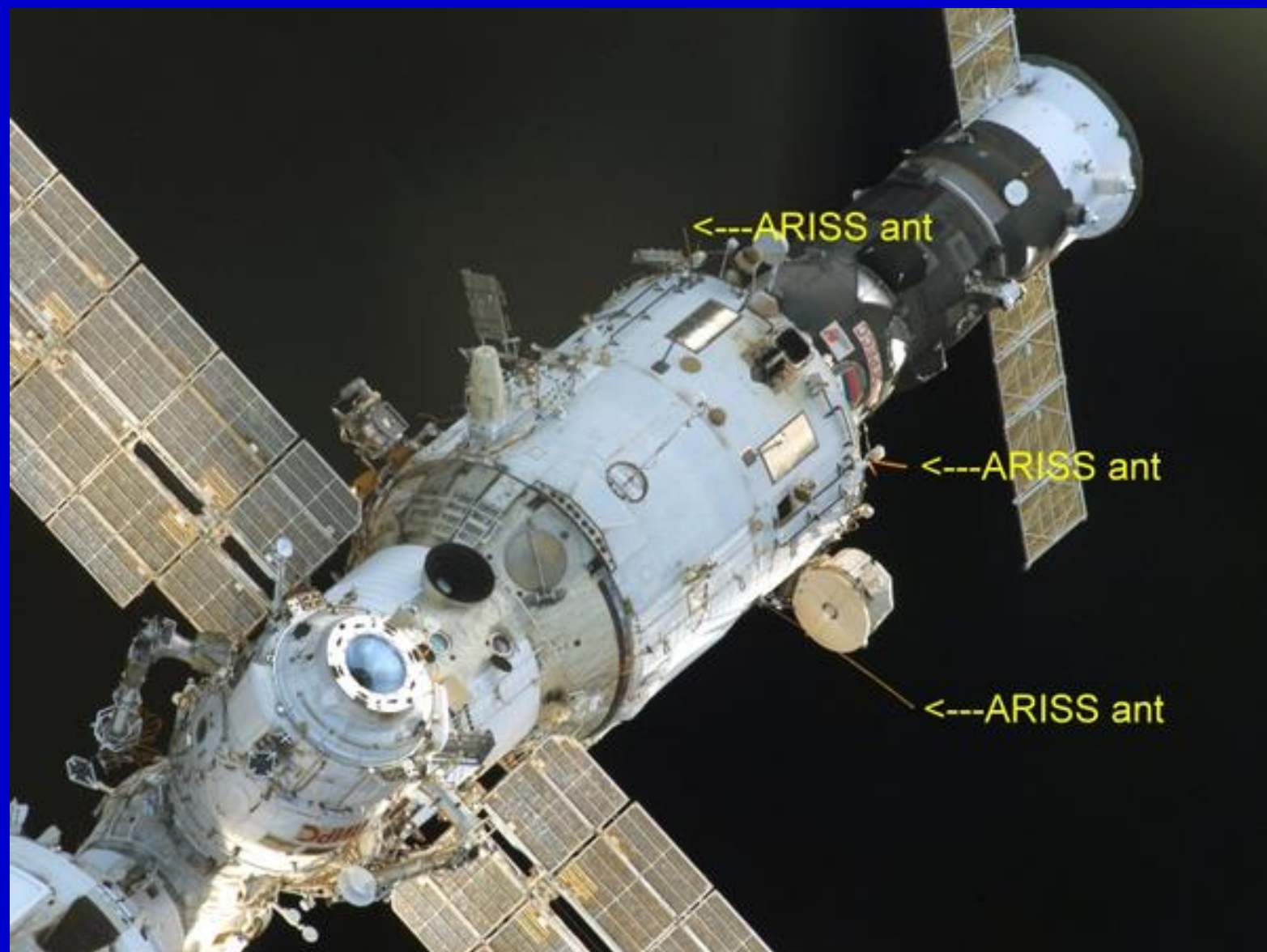
Arrows show radio locations



WA3



ARISS on Zvezda



ARISS on the Columbus Module



ARISS on the Columbus Module



ARISS on the Columbus Module

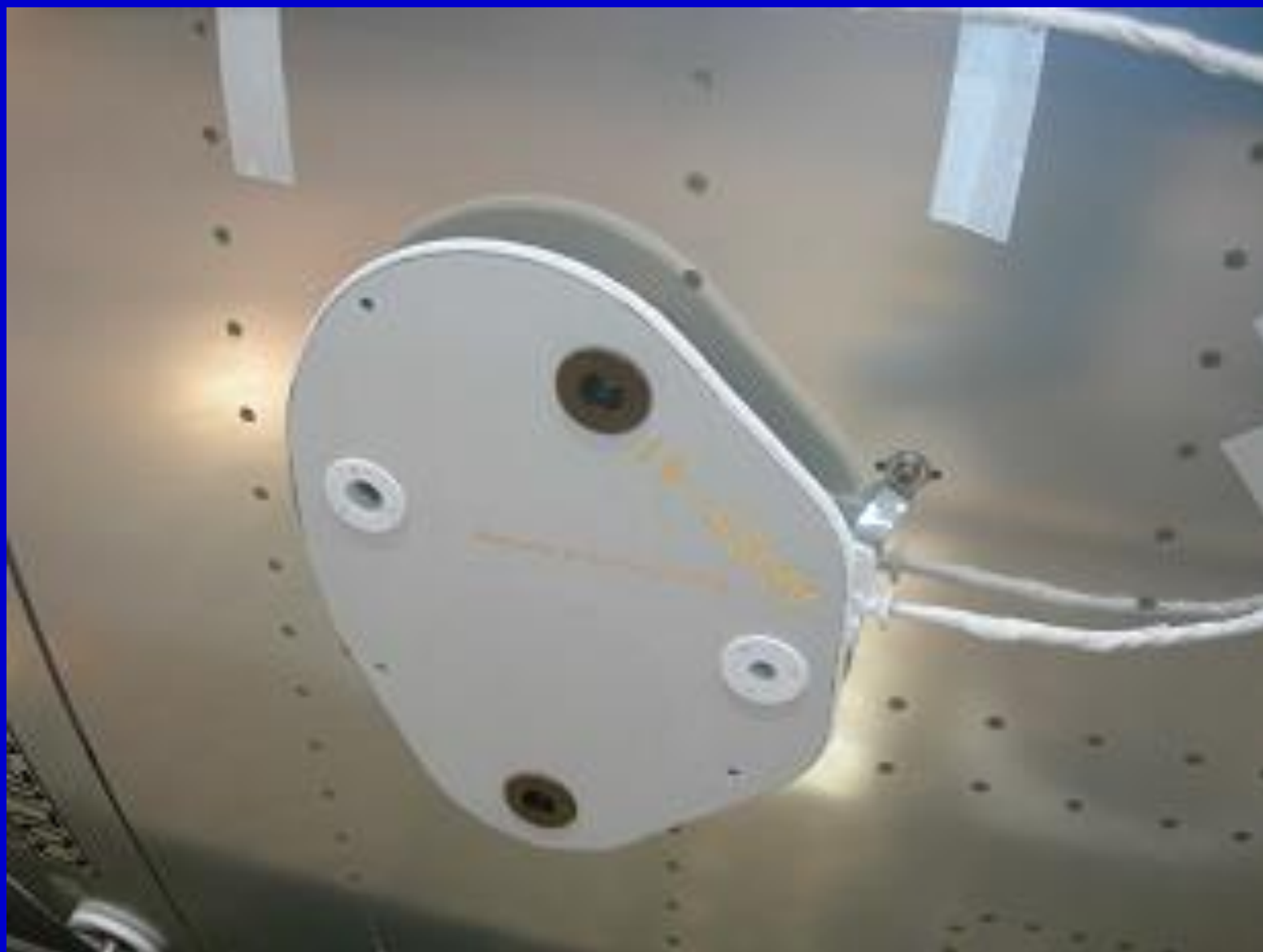


Photo taken during a telebridge contact with the University of Colorado Amateur Radio Club and Northridge Elementary School in Boulder, CO via IK1SLD on 2019-09-24 at 17:43 UTC with max elevation of 86°





Packet Module

ARISS statistics, Country count

66 Countries 1403 Events/1336 Contacts

1	Chile, Costa Rica, Cyprus, French Guyana, Guantanamo Bay Base Cuba, Lithuania, Mali, Monaco, Montenegro, Morocco, Nepal, Northern Ireland, Philippines, Republic of Belarus, Slovenia, State of Vatican City, The Republic of Trinidad and Tobago, Venezuela	18	Switzerland
2	Bulgaria, Hungary, Ile de La Réunion, Luxembourg, Norway, Republic of Korea, Romania, Senegal, Serbia, Uruguay	21	Poland
3	Austria, Croatia, Czech Republic, Ecuador, Israel, Taiwan, Thailand, United Arab Emirates	34	United Kingdom
4	Finland, Ireland, Kuwait, New Zealand, P.R. China, Peru	43	Belgium
5	South Africa, Sweden, Ukraine	45	Germany
6	Brazil, Turkey	53	France
7	Argentina, Greece	68	Australia
8	Portugal	98	Canada
11	India	99	Japan
13	The Netherlands	120	Russia
15	Malaysia	158	Italy
16	Spain	456	USA

ARISS statistics Expedition count

66 Countries 1403 Events/1336 Contacts

1	STS-116, STS-118, STS-128, TMA8/TMA7, TMA9/TMA8	21 53
2	5 Taxi De Winne, Soyuz 16S/15S, Soyuz 8/7, TMA3/TMA2, TMA5/TMA4	22 24, 3, 55
3	61, Soyuz 61S/58S, STS-120, TMA6/TMA5, TMA7/TMA6	23 10
4	4 Taxi Shuttleworth, 41, Soyuz 14S/13S	24 28, 38, 58
5	45, Soyuz 15S/14S, Soyuz 18S/17S	25 14, 30
6	39	26 42, 59
7	1, 23	27 19
8	21	29 44
9	31, 33	30 50
10	16	31 34, 40
12	35, 43, Soyuz 17S/16S	37 29, 36, 52
13	37, 51, 8	38 12, 46
14	2, 5, 54	39 15, 26, 27, 32
15	9	40 56
16	48, 62	46 60
17	13, 22	50 18
18	11, 17, 4, 49, 6, 7	54 20
19	47	

ARISS statistics

• ISS Op	Number
• Paolo Nespoli IZØJPA	85
• Luca Parmitano KF5KDP	65
• Sunita Williams KD5PLB	55
• E. Michael Fincke KE5AIT	54
• William McArthur KC5ACR	37
• Frank De Winne ON1DWN	35
• Koichi Wakata KC5ZTA	33
• Alexander Gerst KF5ONO	33
• Thomas Pesquet KG5FYG	28
• Samantha Cristoforetti IZØUDF	25
• Donald Pettit KD5MDT	25
• Timothy Peake KG5BVI	23
• Chris Hadfield KC5RNJ/ VA3OOG	23
• Leroy Chiao KE5BRW	23

Exotic locations of ARISS School contacts

- Antennas are best set up on the roof.
- Here is how a few schools have done it.
- Note that winter is the perfect time to put up antennas! Next few slides show what winter snow looks like if you haven't seen it before.

Setup for ARISS#1 2000-12-21 Burbank School Burbank, IL





SNOW





This is a parka
For full winter wear



Field repair of rotor control cable
Temps with wind chill -30 degrees

Adler Planetarium ARISS#82

2002-12-29 Chicago, IL



Good Shepherd/ St. Paul ARISS#141 2004-08-10 Tullahoma, TN

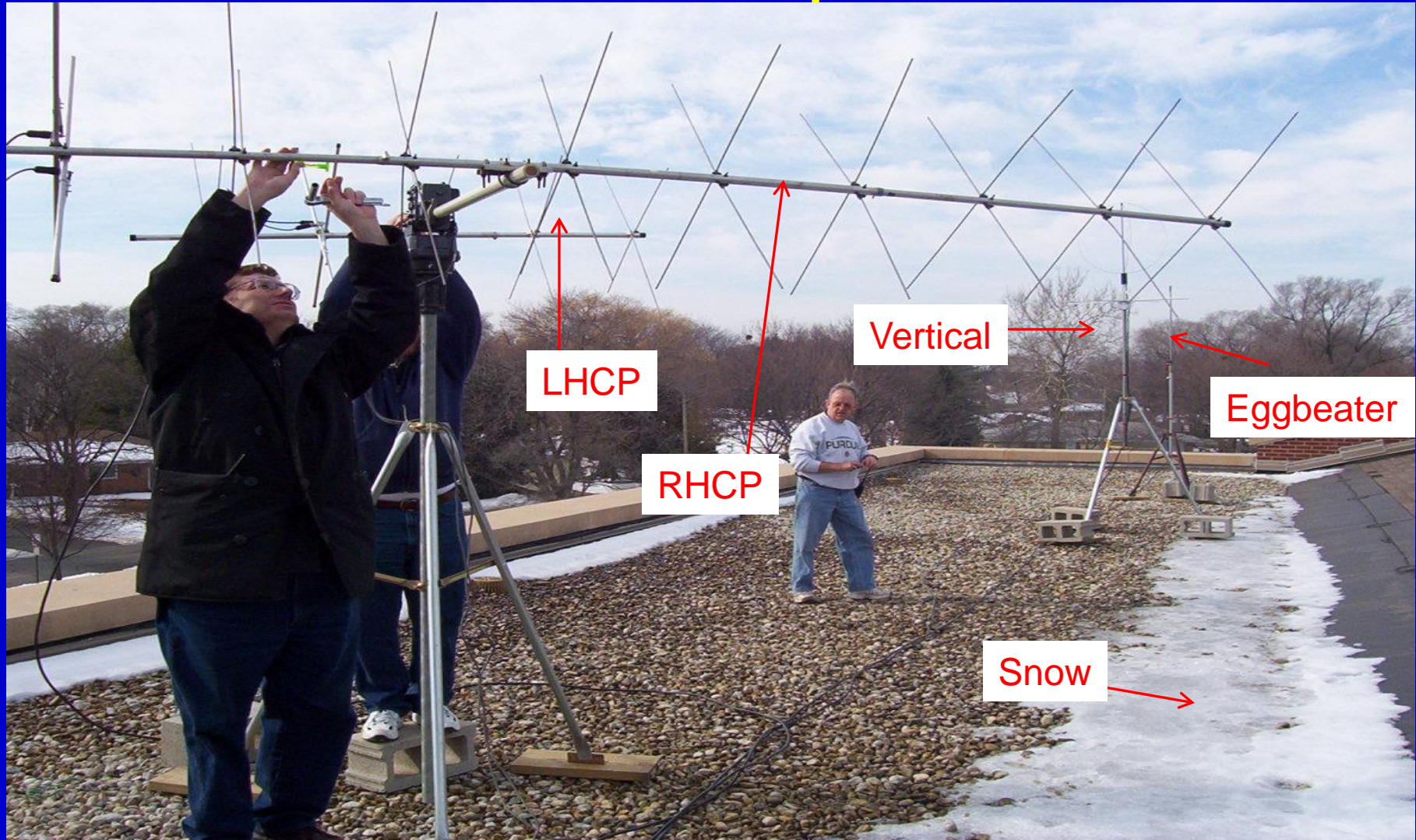


Challenger Learning Center

ARISS#142 2004-08-16
Bloomington, IL



Fairview Elementary ARISS#164 2005-02-10 Mount Prospect, IL



Liberty Junior High
ARISS#710 2012-03-14
Burbank, IL



Liberty Junior High ARISS#710 2012-03-14 Burbank, IL



Contact!

Are we having fun yet?

Happy students

Kolling Elementary ARISS#31 2001-10-30 St. John, IN



Fairview Elementary
ARISS #164 2005-02-10
Mount Prospect, IL



Challenger Learning Center

ARISS#142 2004-08-16

Bloomington, IL



Kansai Ham Festival 2002

ARISS#67 2002-08-02

Hirakata, Osaka Japan



Good Shepherd/ St. Paul
ARISS#141 2004-08-10
Tullahoma, TN



Lively District Secondary School
ARISS#101 2003-06-12
Lively, Ontario Canada



Joamie Iniarvik ARISS#74

2002-09-27

Iqaluit, Nunavut Canada



Greenfield Central High School

ARISS#28 2001-10-16

Greenfield, IN



Scoutinggroep ASCANEN ARISS#77

2002-10-20

Lelystad, Flevoland Netherlands



World Scout Jamboree 2003

ARISS#83 2002-12-31

Sattahip, Thailand



Kursk Technical University

ARISS#47 2002-02-28

Kursk, Russia



Stanley Clark School
ARISS#71 2002-09-04
South Bend, IN



Celia Hayes Elementary School

ARISS#1384 2020-02-25

Rockwall, Texas



Application process

- Twice a year for about 2 months each time, ARISS will accept proposals.
- Spring window is for the first half of the next year. Fall window is for the second half of the next year.
- Latest information may be also found at <http://www.ariss.org/index.html> or www.arri.org

Application process

- ARISS will select schools initially based on educational proposal.
- Once these schools are selected then final acceptance depends on the successful completion of an equipment list.

Proposals will be evaluated based on the following criteria:

Education

Logistics

Outreach

Reporting

Application process

- U.S. education organizations interested in hosting an ARISS scheduled contact will find information about submitting a proposal below. (International schools should submit applications following instructions provided on the **ARISS Program website:**
<http://www.ariss.org/>

Application process

- Educational proposals should include plans for students to:
- study topics related to space technology, space exploration, or space research, and,
- learn about communication, wireless technology, and radio science

Application process

- The more advance preparation educators make with educational plans, the more learning and value the ARISS event will have for students. Imagine your students interviewing an astronaut in space, maybe even using an antenna your students have assembled!

Application process

- ARRL's Education & Technology Program and NASA offer valuable resources to help you and your students learn about wireless technology and satellite communications and space exploration. Go to ARRL's web page: **Preparation for an ARISS Contact** for links to those resources.

Application process

- Application/proposal window for US schools is now open for a contact between July 1, 2021 and December 31, 2021
- The window ends November 24, 2020
- Full details are found at: <http://www.ariss.org>

ARISS Contact Timeline

Pre-contact

Pre-contact

- About 6 months before the contact a mentor is assigned to the school.
- Mentor contacts the school to determine if they are still interested.
- Mentor gives the school best weeks predictions.

Pre-contact

- School informs mentor what weeks will work.
- About 1.5 months out, mentor presents a week with predicted times for each day and asks for priority order. Also asks for short story on the school and the student names with their questions.
- School picks top 5-7 days.

Pre-contact

- Top 5-7 days are presented to the ISS planners.
- Pray the ISS planners will pick one of the days. Yes, the Flight Surgeons are god!
- About 10 days to 14 out, a confirmed time is hopefully presented. We have had the confirmed date given to us as late as 36 hours out. We have been aborted the morning of a contact, about 10 minutes before AOS.

Pre-contact

- Saturday before the contact day is suggested setup day. Test test test test. Did I say test everything?
- Early morning of contact day. Final preparations. **TEST TEST TEST EVERYTHING WITH A FULL END TO END CHECK!**
- Minutes before contact. Don't have a panic attack. I tell the audience that they are not allowed to panic unless I panic.

ARISS Contact Timeline

Contact

Contact time

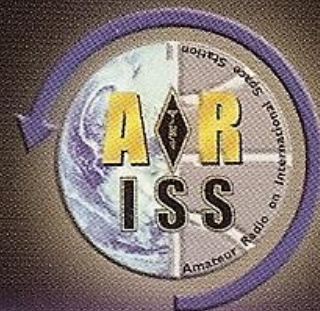
- 10 minutes of the most stressful yet fun time in your life. Remember that this is an experiment and experiments do fail.
- Almost relief! Hang in there!
- Pray the equipment keeps working. Think of this as a Super Field Day.

ARISS Contact Timeline

Post-contact

Post-contact

- Let it all hang out! You did it!
- Have everyone sign the log.
- Send for QSL. The kids create their own QSLs.
- Final report with Mentor. We want digital pictures and audio files ASAP.
- Take the ARISS survey. Basically required and helps keep the funding going to the ARISS program at NASA.



NA1SS

RSØISS

The **International Space Station (ISS)** is a common project of many nations in **Europe** as well as **Canada, Russia, Japan and the USA**. When fully constructed the ISS will consist of about 70 major components and hundreds of smaller ones that are to be launched into space by the year 2010. Some of the major components are:

- **Zarya**, also called Functional Cargo Block (FCB—acronym from the Russian term) – includes the energy block, contingency fuel storage, propulsion and multiple docking points.
- **Zvezda**, also called Russian Service Module – provides life support and utilities, thrusters and habitation functions (toilets and hygiene facilities).
- **Canadian Mobile Servicing System** – includes a 55-foot robot arm with 125-ton payload capability as well as a mobile transporter that can be positioned along the truss for robotic assembly and maintenance operations.
- **US, European and Japanese Laboratories** – together provide 33 International Standard Payload Racks with additional science space available in the two Russian Research Modules.
- **The Amateur Radio station** – which is frequently used to allow ISS crews and visitors to talk with school children and fellow amateurs around the world.

To:

From

NA1SS

RSØISS

NA1SS confirms 2 way QSO
with AJ9N on 22 Sept., 2006
at 18:25z on 145.80 MHz FM

MHz

Mode: Voice Packet SSTV APRS Repeater SWL

ARISS HAS A BUNCH OF NEW THINGS HAPPENING NOW AND NEAR FUTURE

- We are going to the moon and beyond. Look for ARISS equipment in new places.
- Look for new ways to make contact.

NEW MULTISOURCE POWER SUPPLY FOR InterOperable Radio System (IORS)



Launched on SpaceX CRS-20

March 6, 2020



NEW InterOperable Radio System (IORS)

Launched on SpaceX CRS-20 March 6, 2020



SpaceX CRS-20 launch of March 6, 2020





Transforming STEAM Education & Exploration from Low Earth Orbit (ISS) To Cislunar (Gateway): Amateur Radio Exploration (AREx)

Overview:

- Hands-on engagement, validated by ARISS, enables students (and communities) to be immersed in the wonderment of space exploration
- 10 min ISS pass transformed into 12 hour hemisphere comm opportunities (voice, lunar/Earth pictures, Television, experiment data, Twitter-like messages, telerobot command between schools, etc)
- Leverages ARISS international support, expertise and capabilities (hardware, operations and educational infrastructure) demonstrated on ISS
- Coupled with AMSAT international's deep space satellite development and operations expertise
- Hardware development performed at no cost to space agencies; request launch and integration support

ARISS development, operations, education and student mentoring is performed by world-wide network of amateur radio & educator volunteers





AREX OPERATIONAL SEGMENTS



Space Segment
Crew Tended | Autonomous



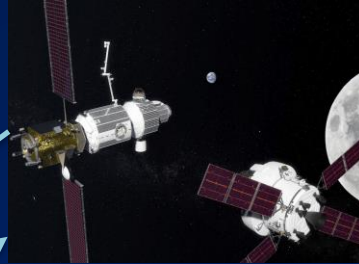
User Segment
Educational Outreach | Amateur Ops | Experimental Scientific



Operations Control Segment
Nominal | Contingency Ops



AREX OPERATIONAL SCENARIOS



X-Band (10.45-10.5 GHz)
C-Band (5650-5670 MHz)

Operation Plan:

Nominal: X-band TX Prime; 70 cm Rx only
Contingency: 70 cm TX Prime; X-band TX off

70 cm Band (435-438 MHz)
AREX contingency ops
X-Band (10.45-10.5 GHz)
C-Band (5650-5670 MHz)



Users

- Schools & General Public (RX only)
- Amateur Radio Operators (RX & TX)
- Experimental/Scientific (RX & TX if licensed)

AREX Gnd Stations

- Cmd
- TLM
- Contingency



Bochum, GAVRT, & Goonhilly



Telebridge Network

BATC Server RX Distribution

- Watch for future announcements on the latest ARISS and AREx news.
- Contributions to the program are most welcome. To donate check out: <https://www.amsat.org/donate/> and click on ARISS Donations

Charlie Sufana AJ9N • aj9n@aol.com

Your Questions