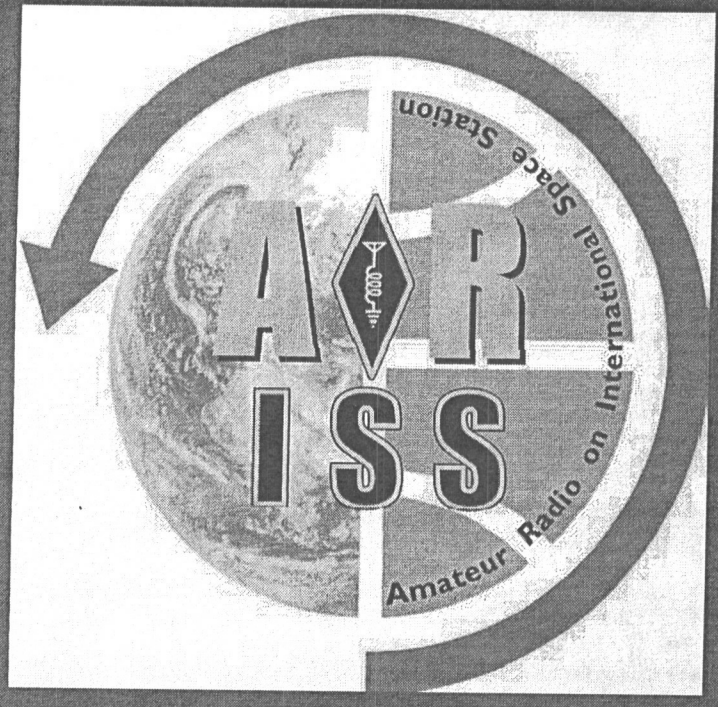
Human Spaceflight Update: ARISS, the Moon and Mars

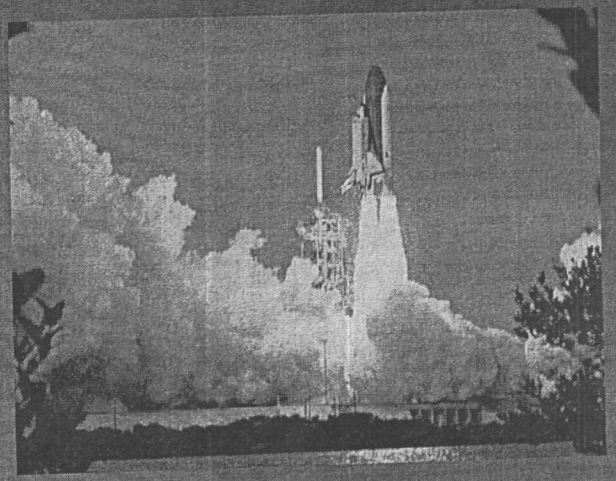


Dayton Hamvention
May 21, 2005

Frank H. Bauer, KA3HDO
Mark Steiner, K3MS

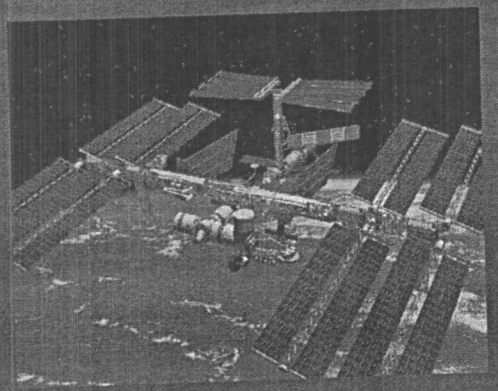
Amateur Radio on Human Spaceflight Missions

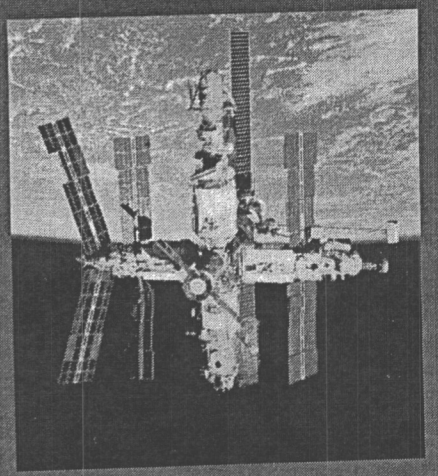
Since 1983, organizations in the U.S. (SAREX), Germany (SAFEX) and Russia (MIREX), have worked with the space agencies to fly amateur radio and to support Educational Outreach on:



Space Shuttle

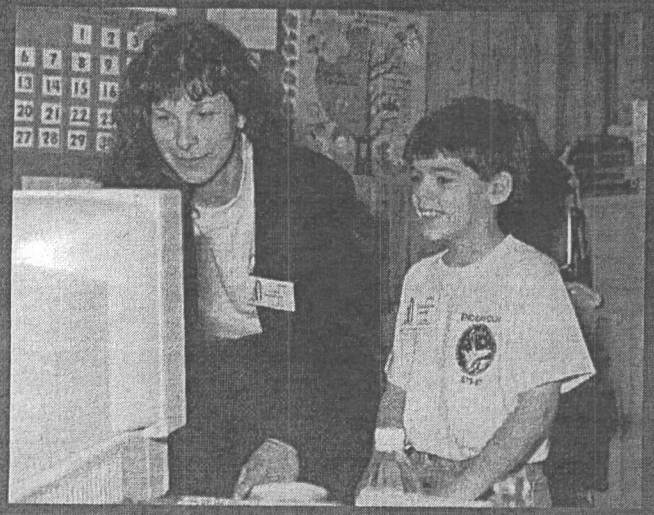
ISS





Mir

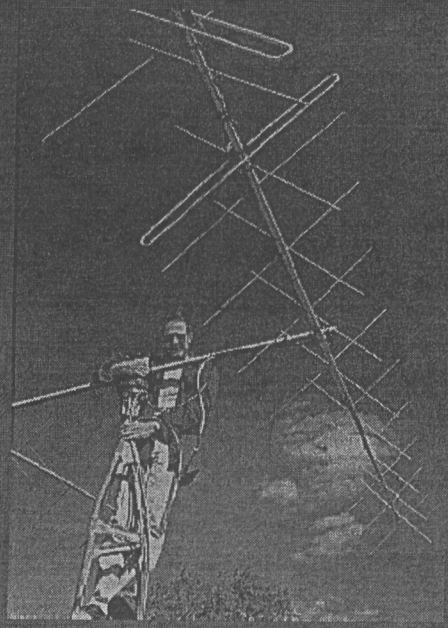
ARISS Objectives



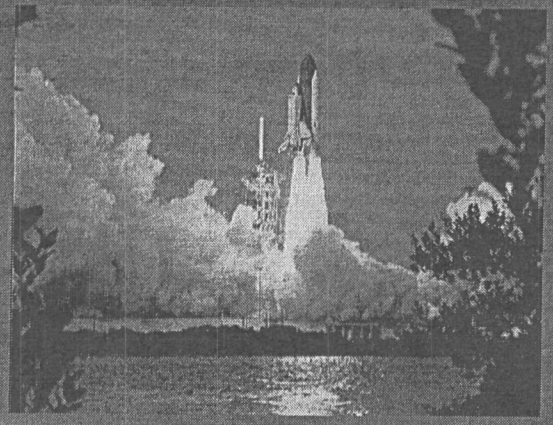
Spark Student's Interest
In Science & Technology



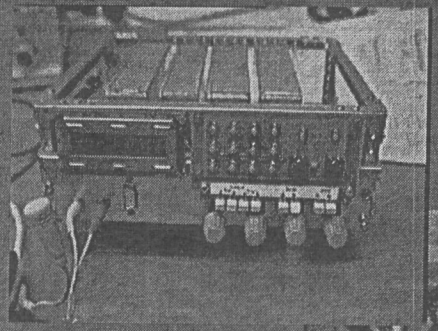
Crew Family Contacts
(Crew Psychological Ops)

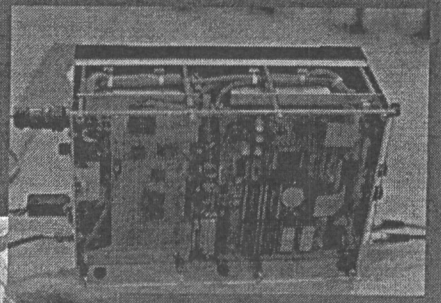


Promote Interest
In Amateur Radio



Human Spaceflight
Awareness







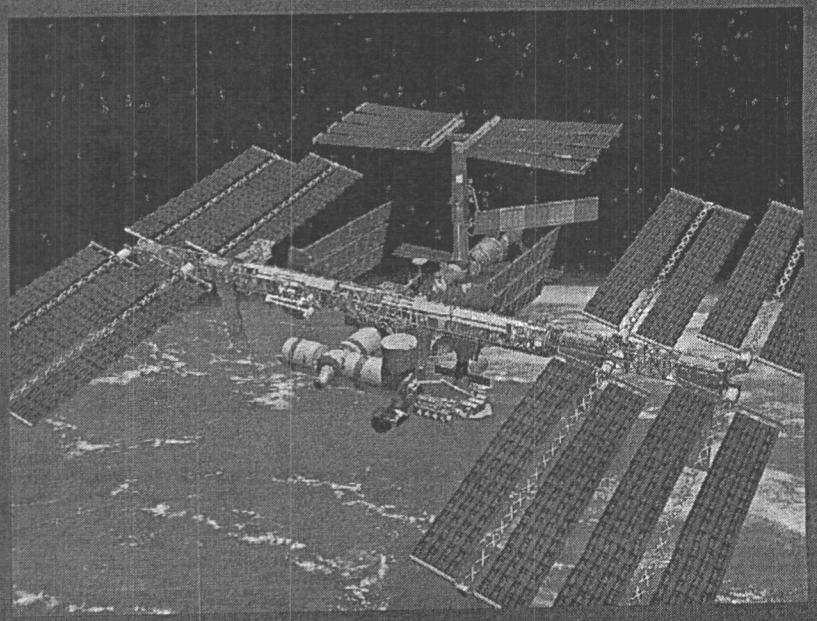
Experimentation

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



ГИДЗЕНКО КРИКАЛЁВ
SHEPHERD

Nov 2000 – Mar 2001



Mar 2001 – Aug 2001



Aug 2001 – Dec 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

Expedition 11



Sergei Samburov U5MIR

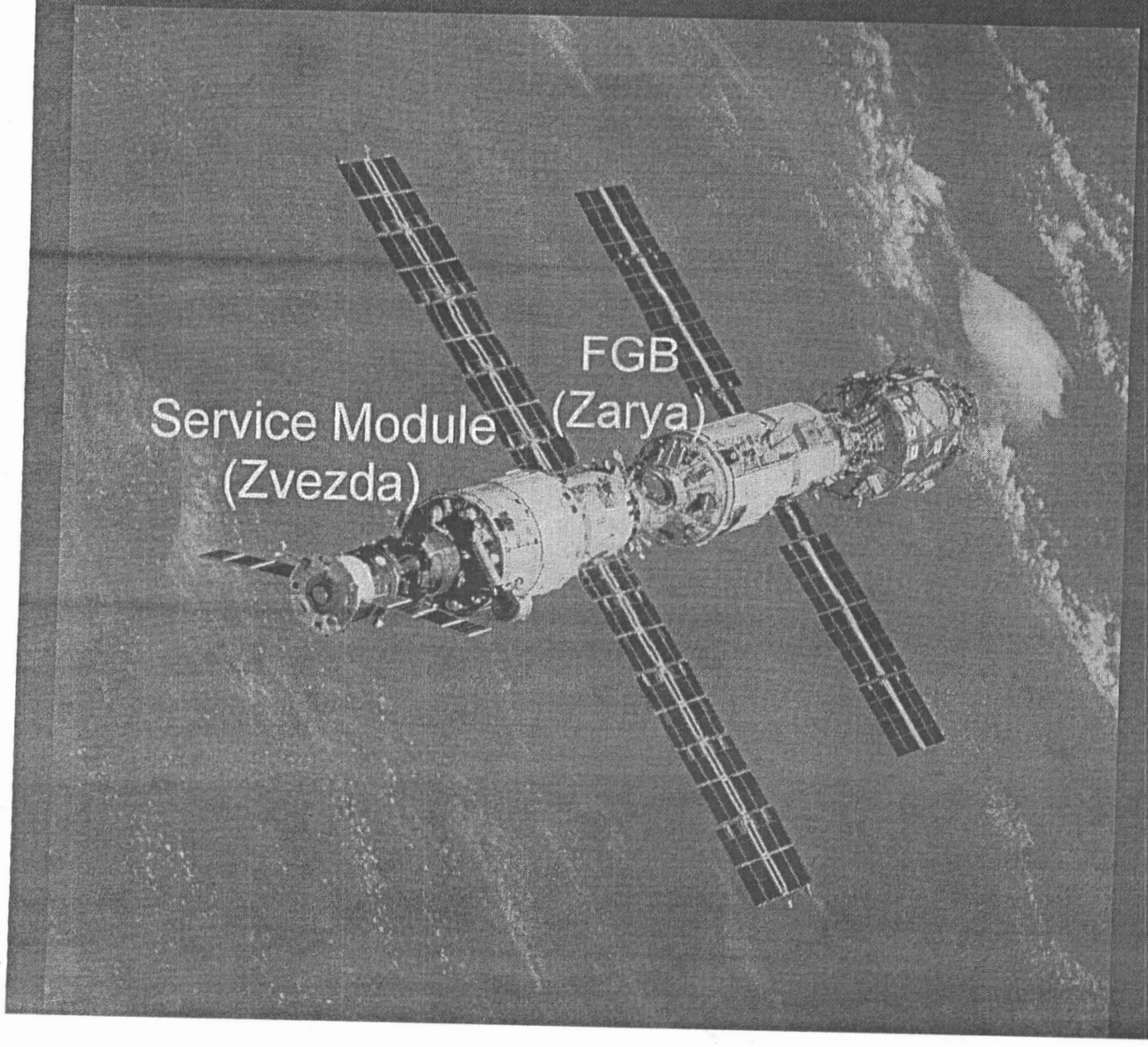
John Phillips KE5DRY

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)**

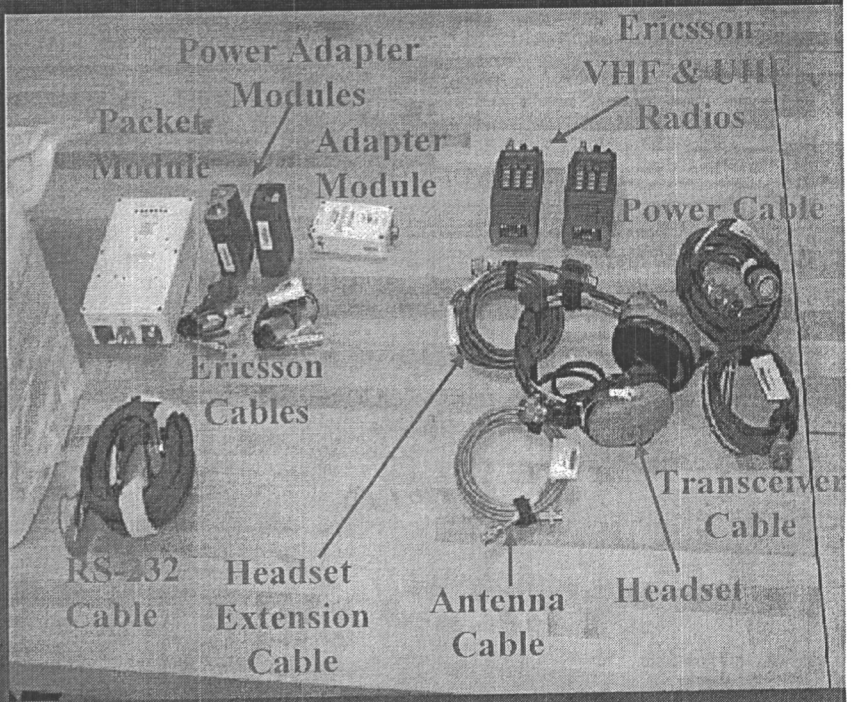
Ham Station Location: Service Module and FGB



- **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**

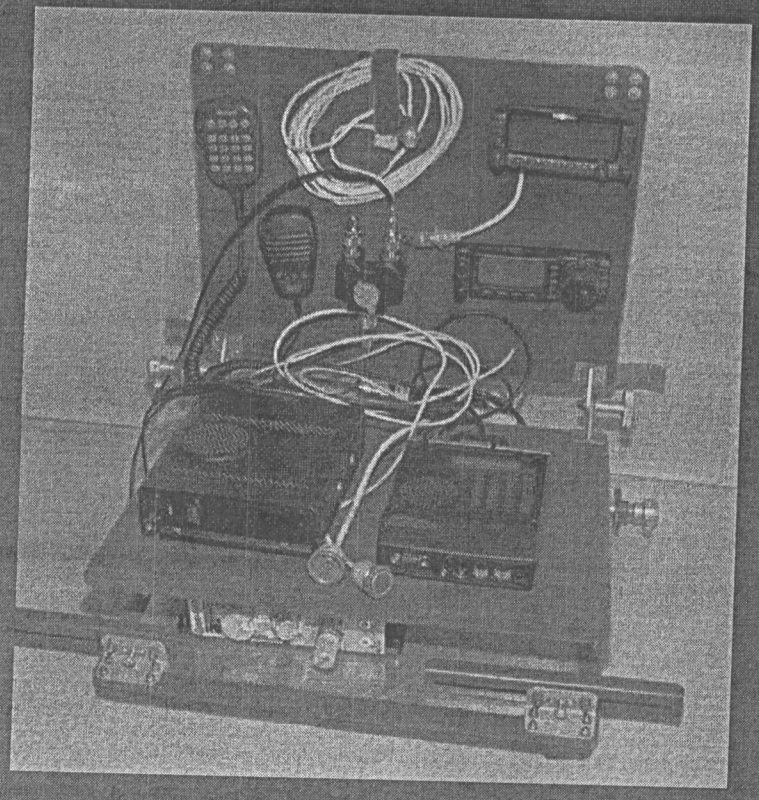
Phase 1 (SAREX) Hardware Status





- **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

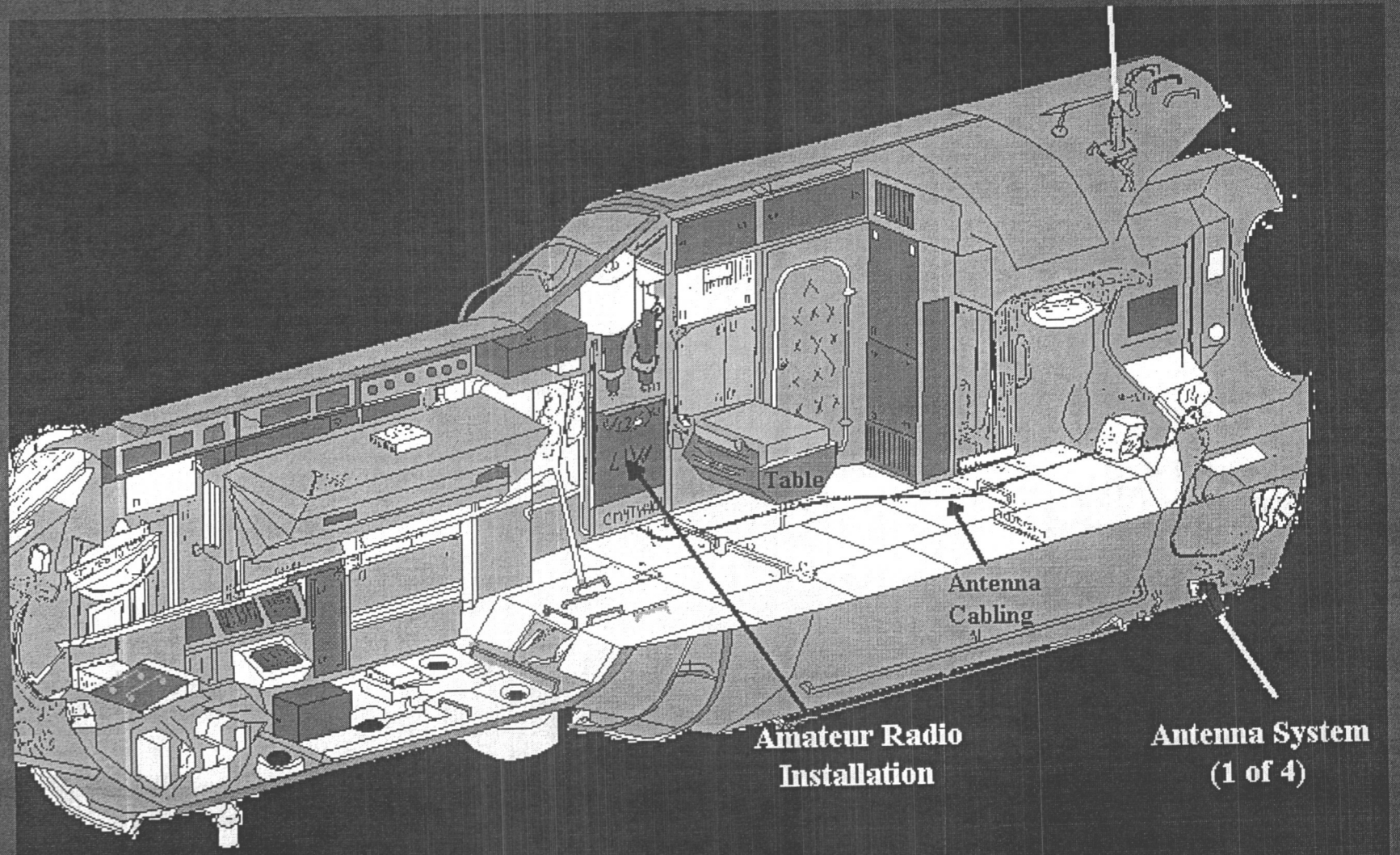
Planned Capabilities for Phase 2 Station



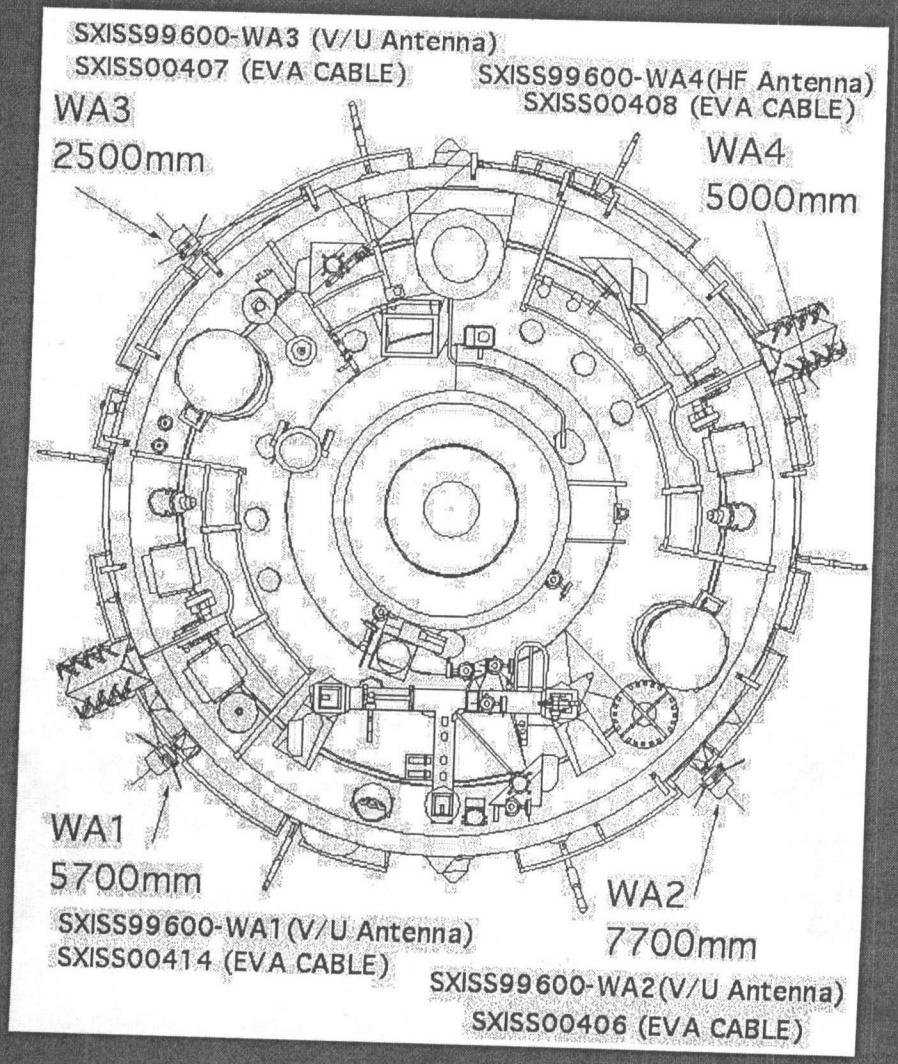
- Phase 1 VHF & UHF Systems
- Higher power (25 W) VHF & UHF FM Radio System
- HF (shortwave) radio system for ionospheric experimentation
- Packet Radio
- SSTV

Supports Multi-Band, Multi Operator
Autonomous and Crew-tended Modes

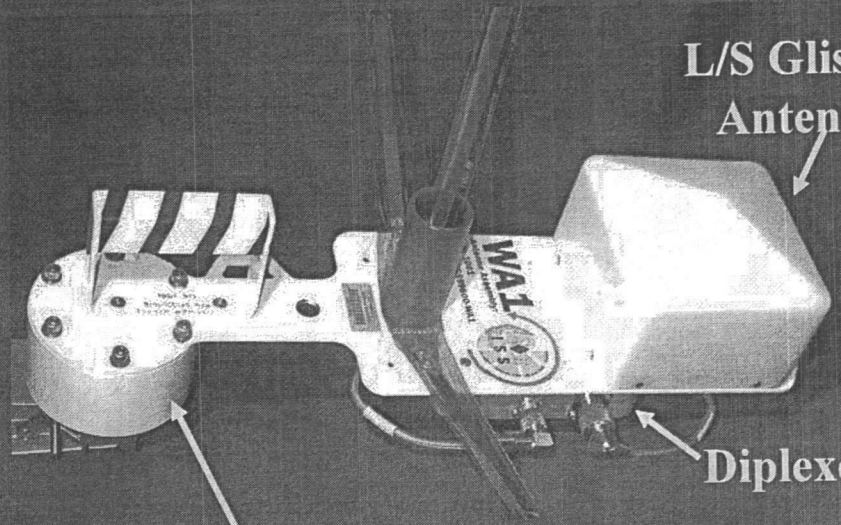
ARISS / ISS HAM
Location in and on the Service Module



Antenna System Installation on Service Module



Antenna System w/ VHF/UHF Antenna Installed (1 of 4)

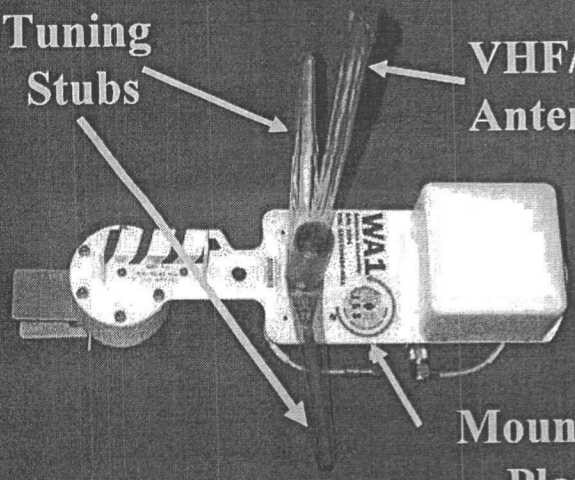


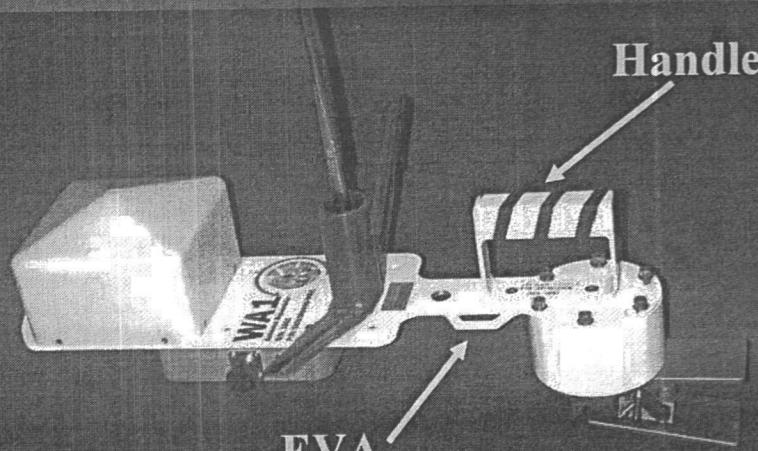
Internationally Developed

Italian Contribution:
- Microwave Antennas
- Diplexer

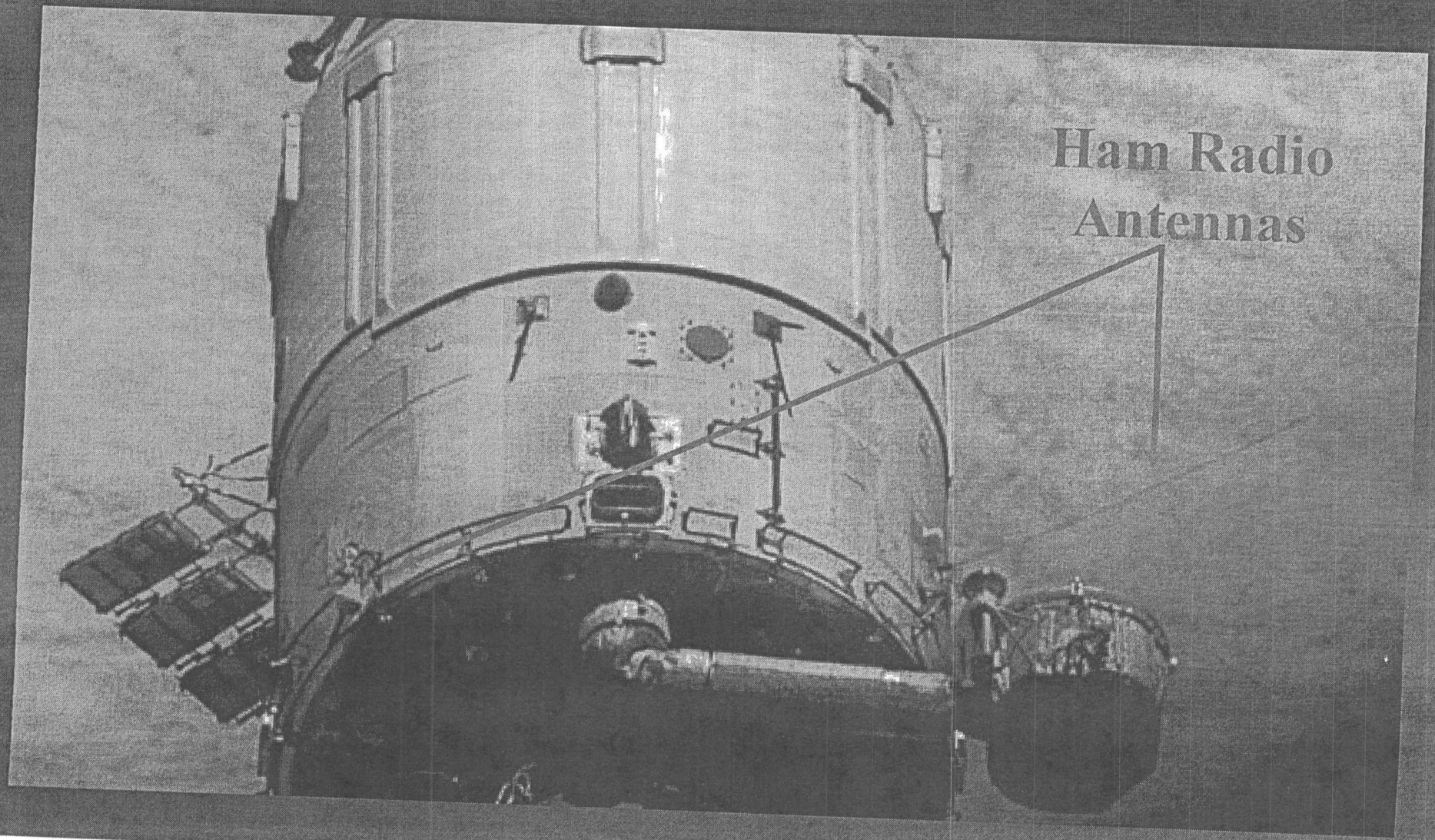
US Contribution:
- Mounting Plate
- Handle & Spacer
- VHF/UHF & HF Antennas

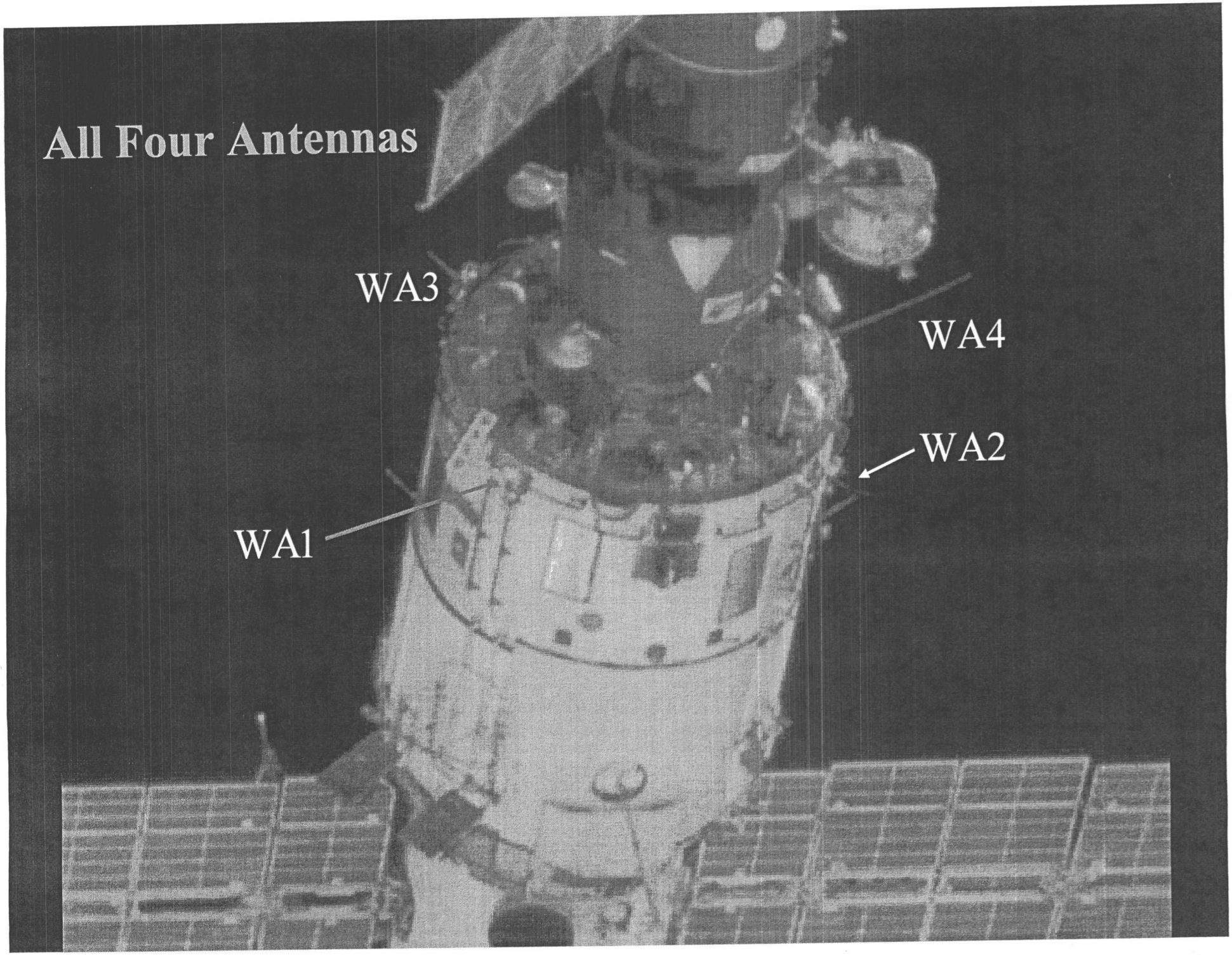
Russian Contribution:
- Handrail Clamp
- Interconnecting Cables

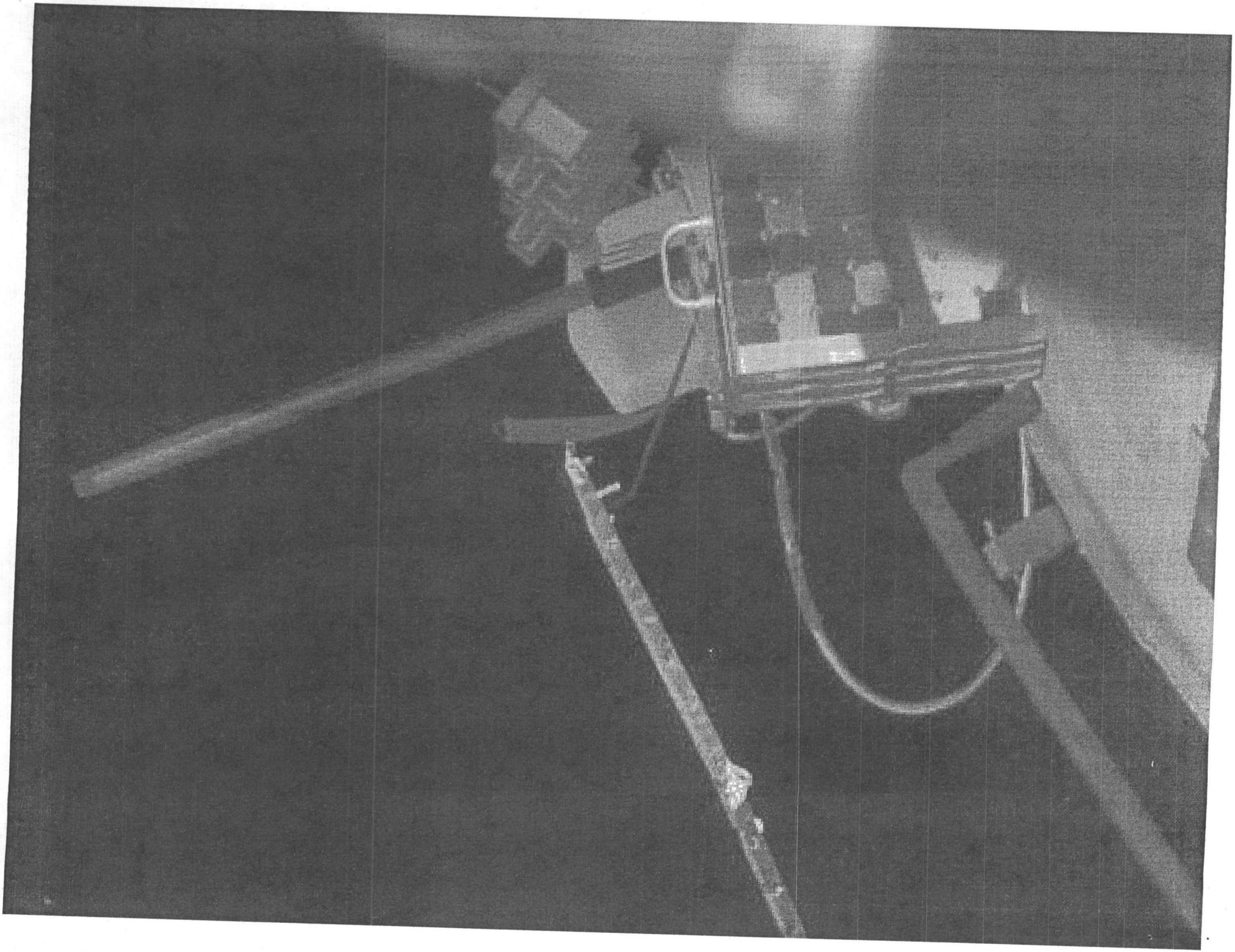




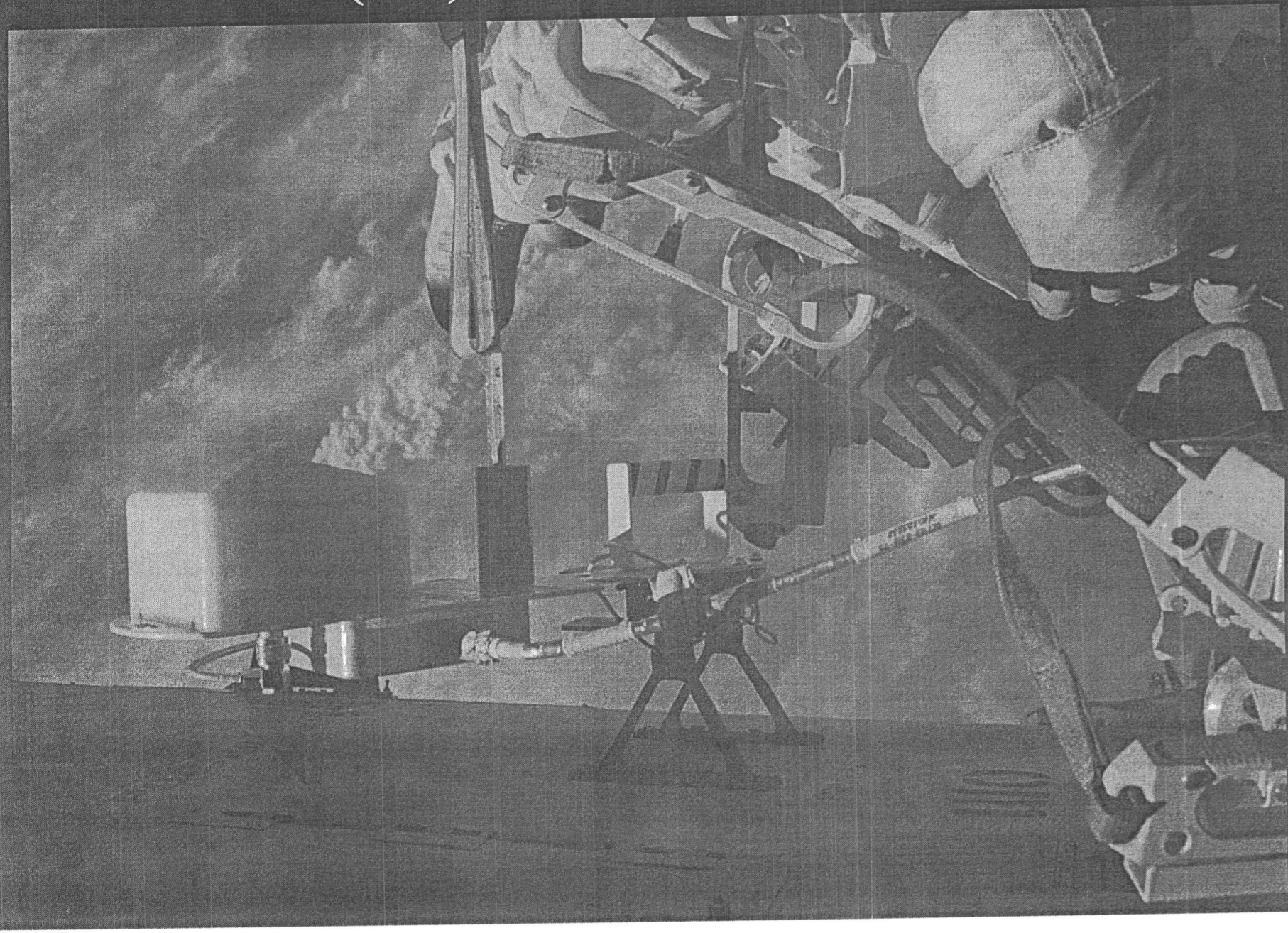
WA3 and WA4 Antennas on Service Module




All Four Antennas
WA3
WA4
WA2
WA1

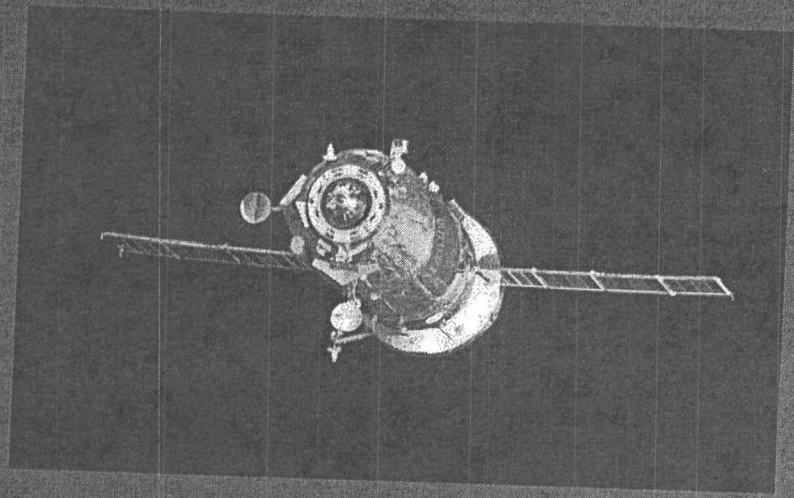


WA4 (HF) Antenna during EVA



Installation/Launch Status (2003-2005)
3 Launches in 3 Years!!

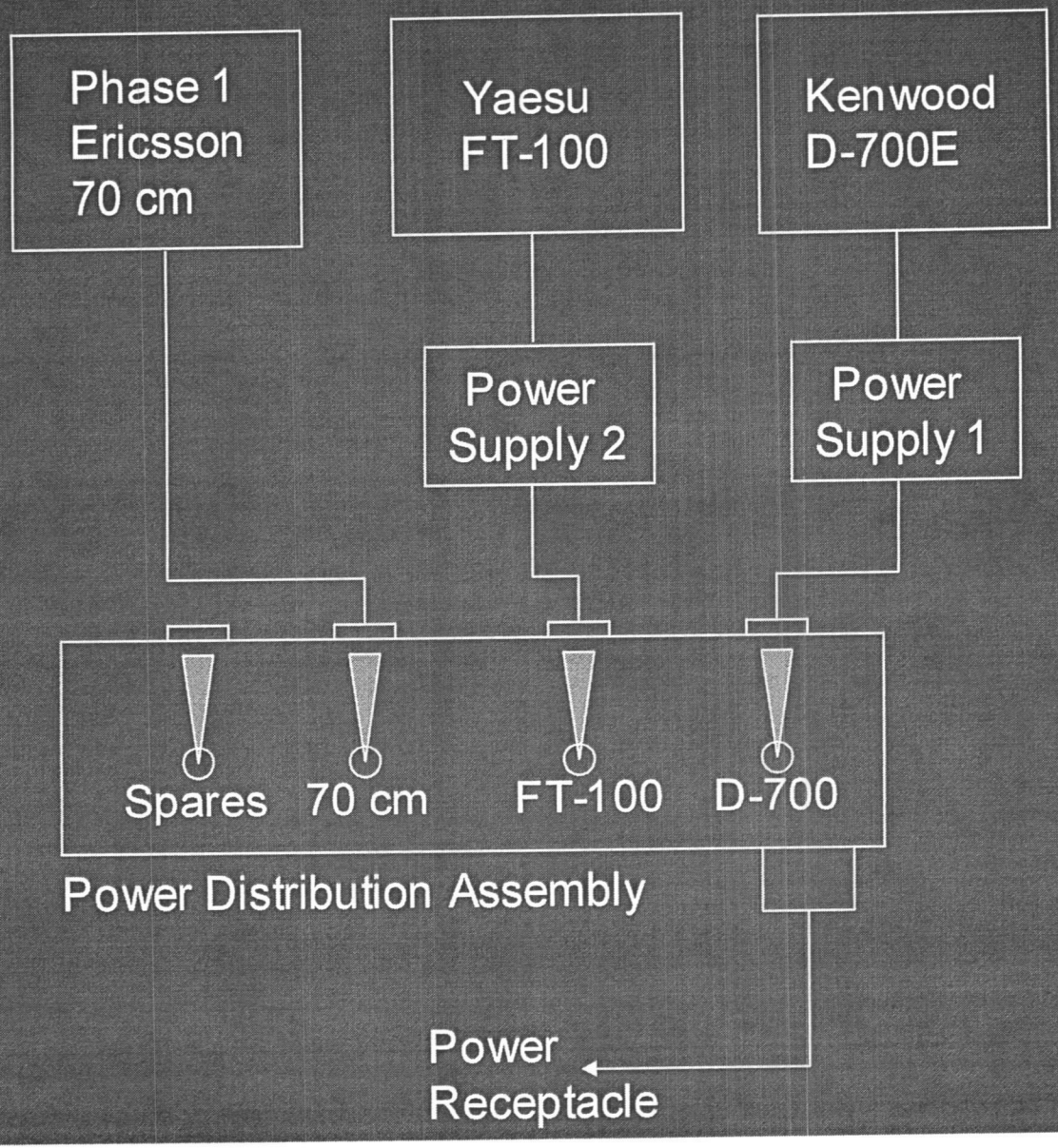
- Progress 12P flight, August 30, 2003
  - Phase 2 Kenwood D-700E Radio System
  - Energia Phase 2 Power Supplies
- Progress 19P flight, Aug 2005
  - SSTV Hardware and Software
  - ARISS Computer
- STS-114 Shuttle Return to Flight, July 2005
  - MISSE-5/PCSAT2 External Payload
  - Phase 1 Headset extension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



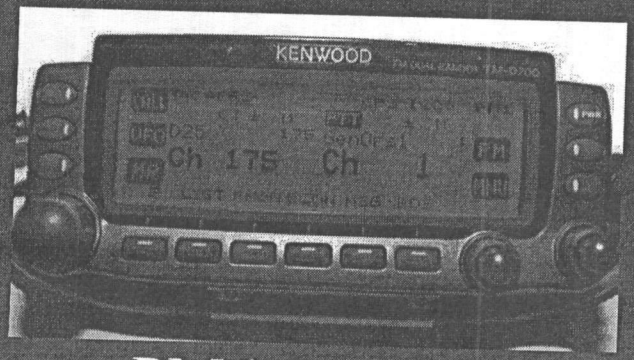
Progress 12P w/ ISS Ham Hardware Prepares to Dock with ISS

Transitioning to Joint Operations in FGB and Service Module

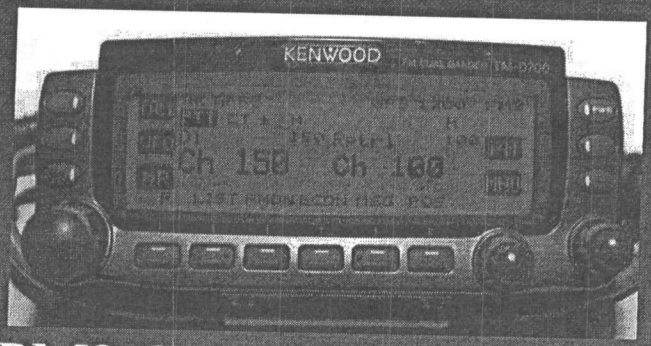
Service Module Hardware Architecture (Phase 1 70 cm and Phase 2)



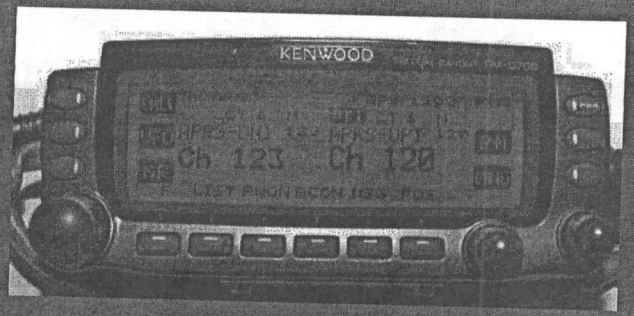
Kenwood D-700E Closeout Photos
5 Program Modes



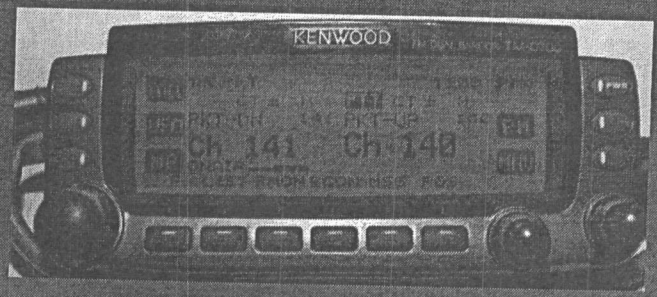
PM 1 Voice



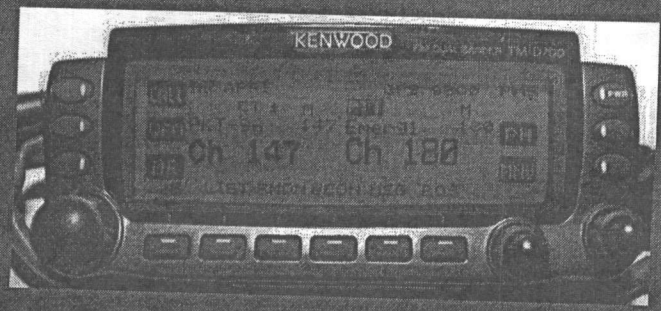
PM2 Crossband Repeater



PM 3 APRS



PM 4 Packet

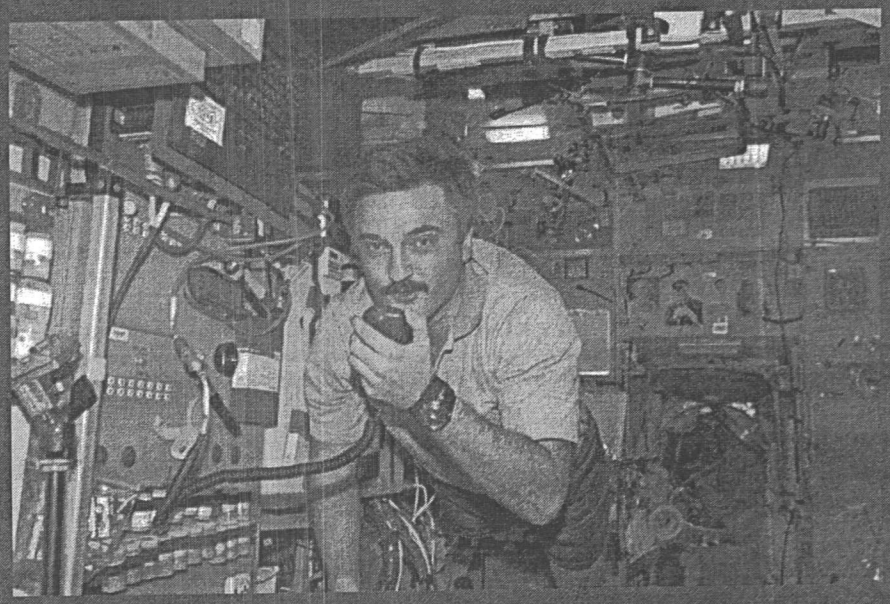


PM 5 Emergency& 9600 Packet

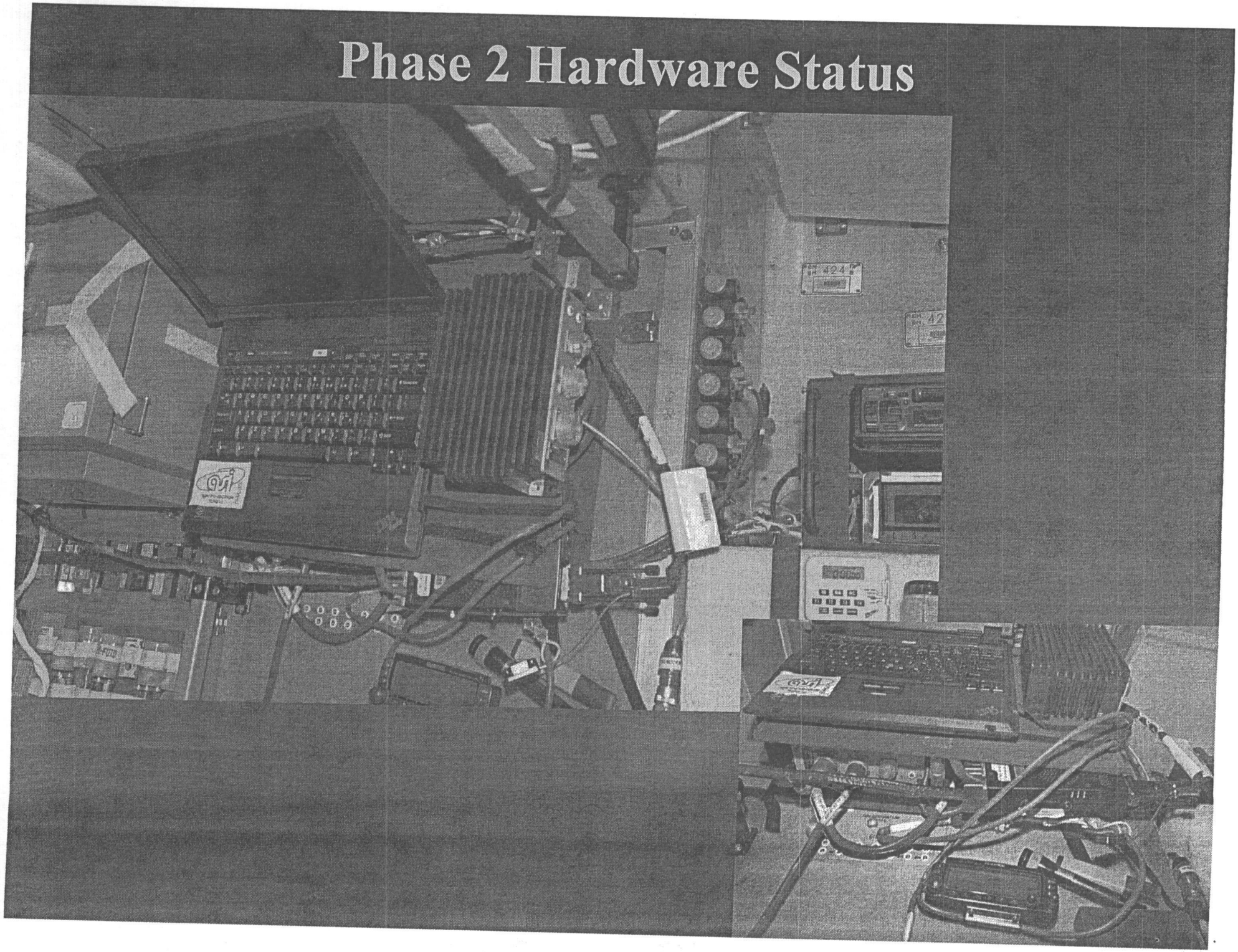
Phase 2 Hardware Status

- Kenwood D700 & WA2 Antenna System Operational on 2 meters and 70 cm
  - General voice QSOs
  - Packet
  - Repeater operations
  - School group operations



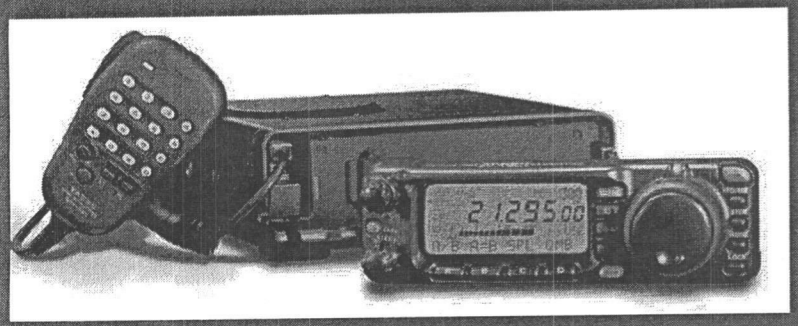


Phase 2 Hardware Status

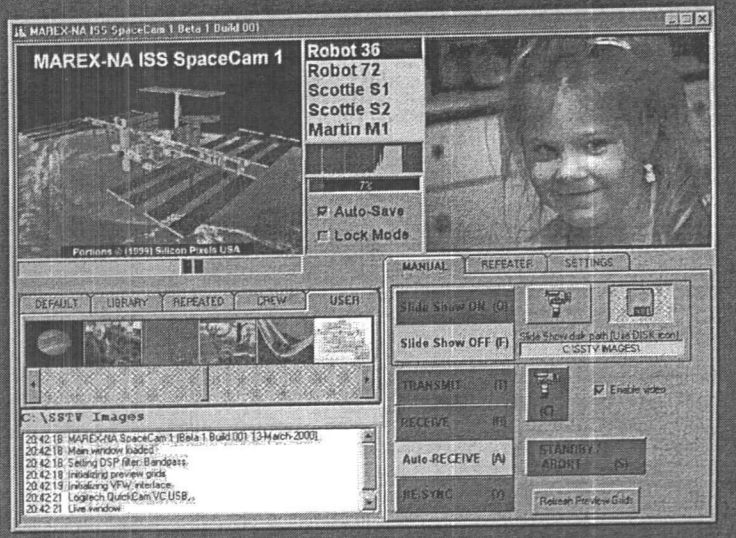


Future ISS Hardware Deployments

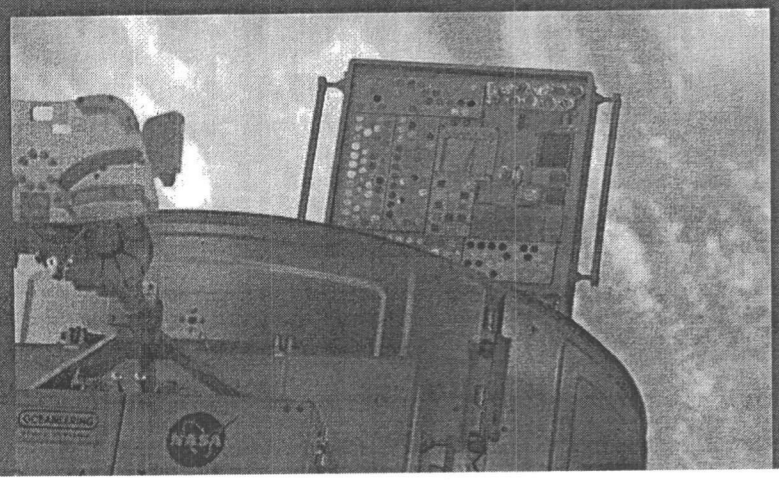
- SSTV—August 2005
- Phase 2 Yaesu hardware—2006?
- External payload—1st payload (MISSE-5/PCSAT2)—July 2005



Yaesu FT-100



SSTV Software



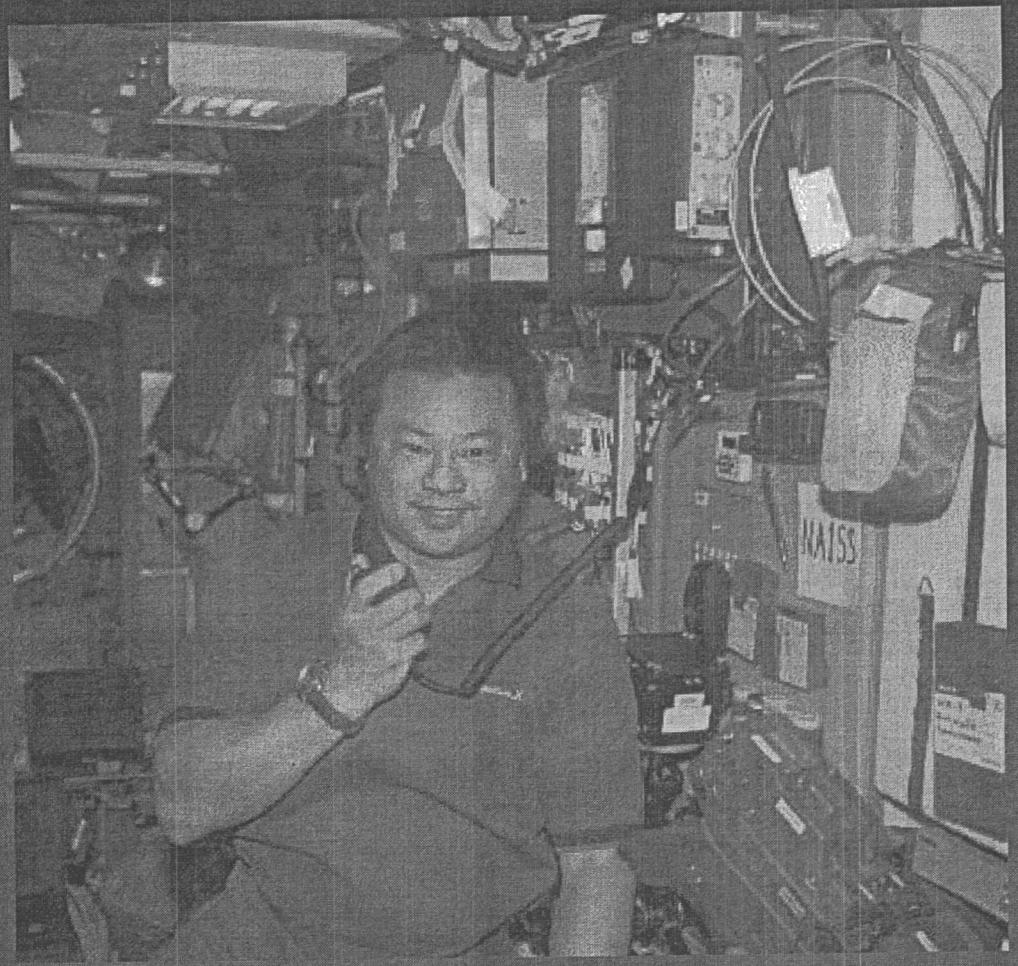
MISSE-5/PCSAT2

- –Packet
- –Repeater
- –PSK31

Operations

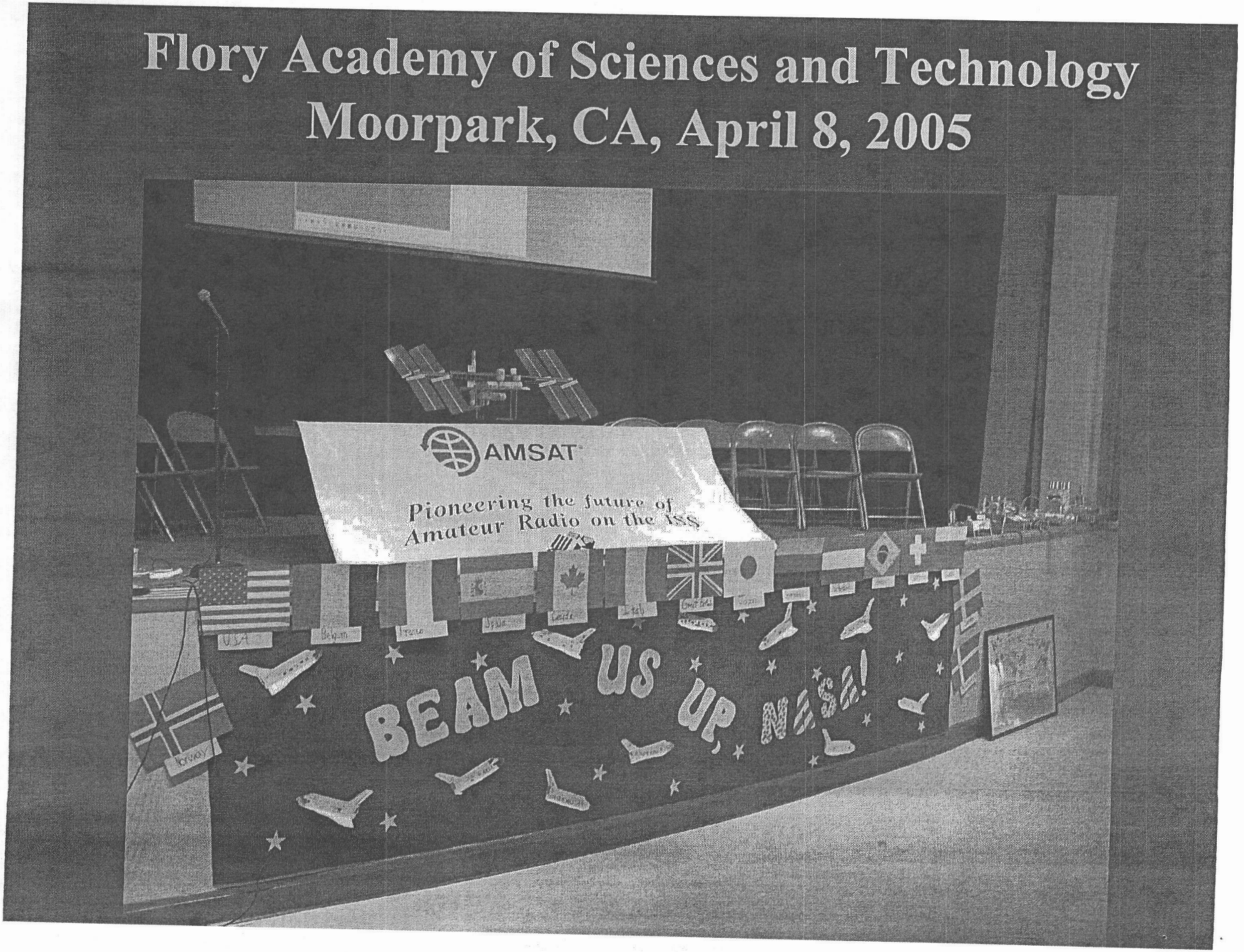
- Downlink:
  - Worldwide both voice & packet: 145.80
- Uplink:
  - Packet: 145.99
  - Region 1 voice: 145.20
  - Region 2 & 3 voice: 144.49
  - Voice Repeater: 437.80
- Callsigns:
  - DL0ISS
  - RS0ISS
  - NA1SS
- Crew Schedule
  - ~0700 to 1900 UTC
  - Off Saturday Noon to Sunday evening

Expedition 10—Leroy Chiao, KE5BRW
Record Number of School Contacts

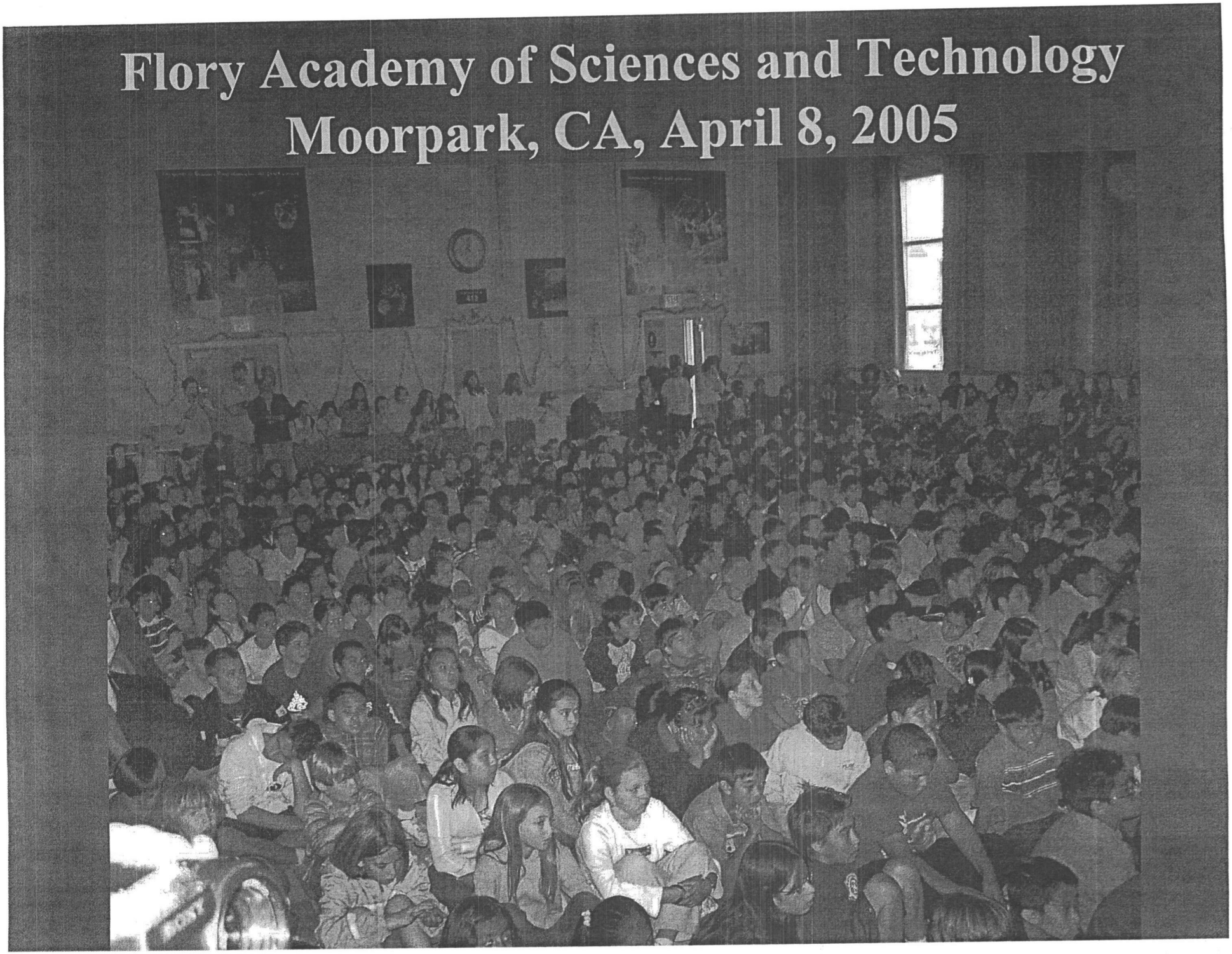


23 Schools—177 total schools to date
Thanks Leroy!!

Flory Academy of Sciences and Technology
Moorpark, CA, April 8, 2005

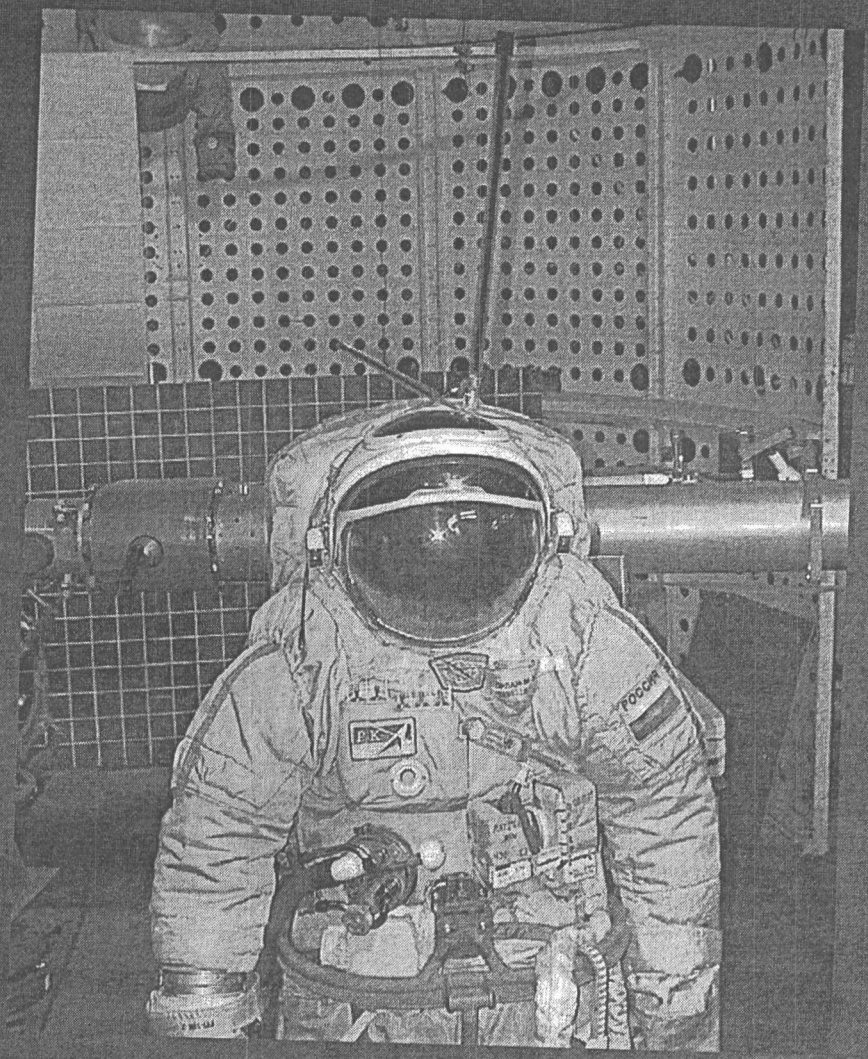


Flory Academy of Sciences and Technology
Moorpark, CA, April 8, 2005



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

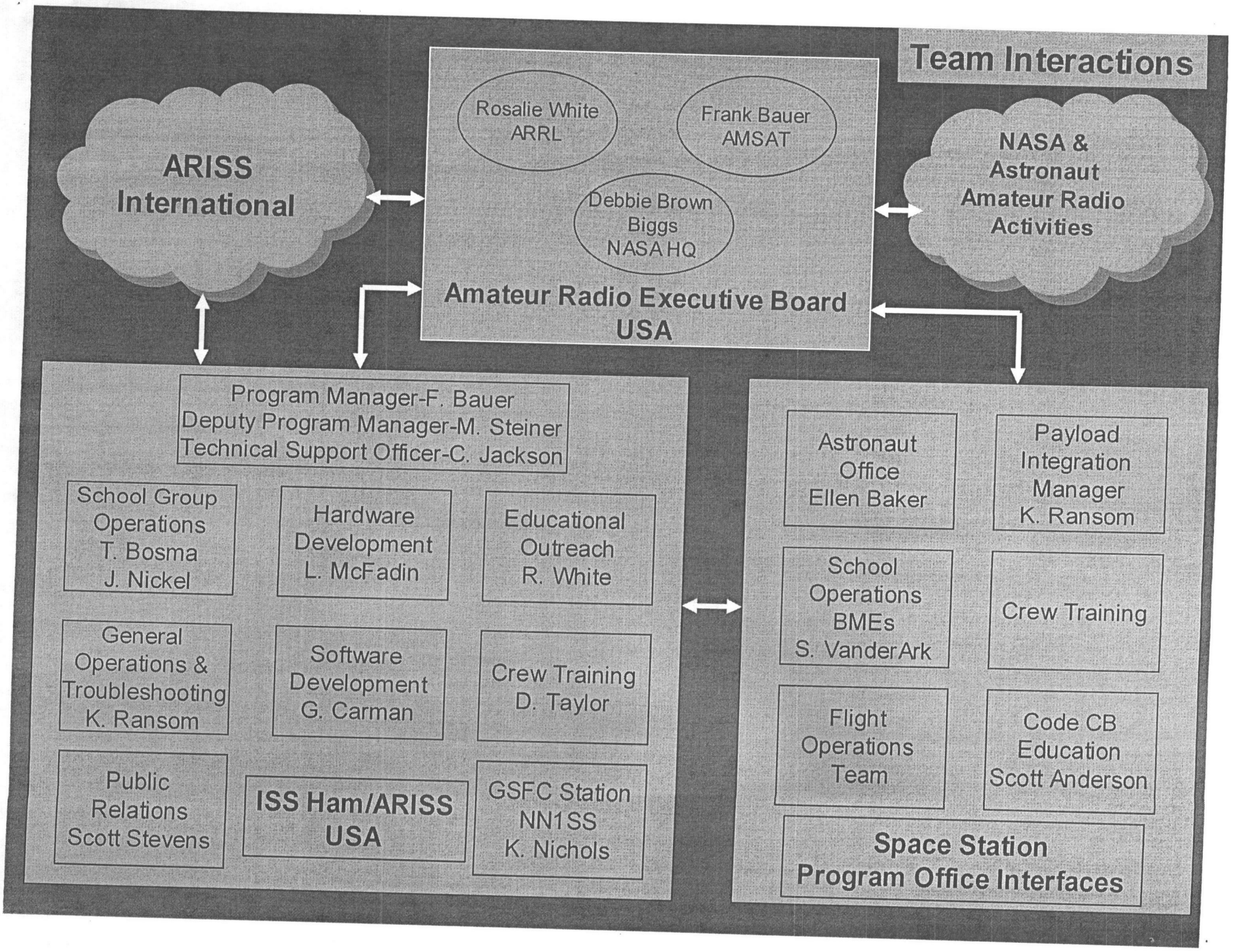
- Russian-led initiative w/ USA Support
- Potential capabilities:
  - Message downlink
  - SSTV
  - Eagle Earth Sensor demonstration
  - Telemetry
  - Schools in Space—DVD/CD with school name, artwork and student names included
- Expected deployment: 9/14/05
- Expected Freqs of Operation: 145.99 MHz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

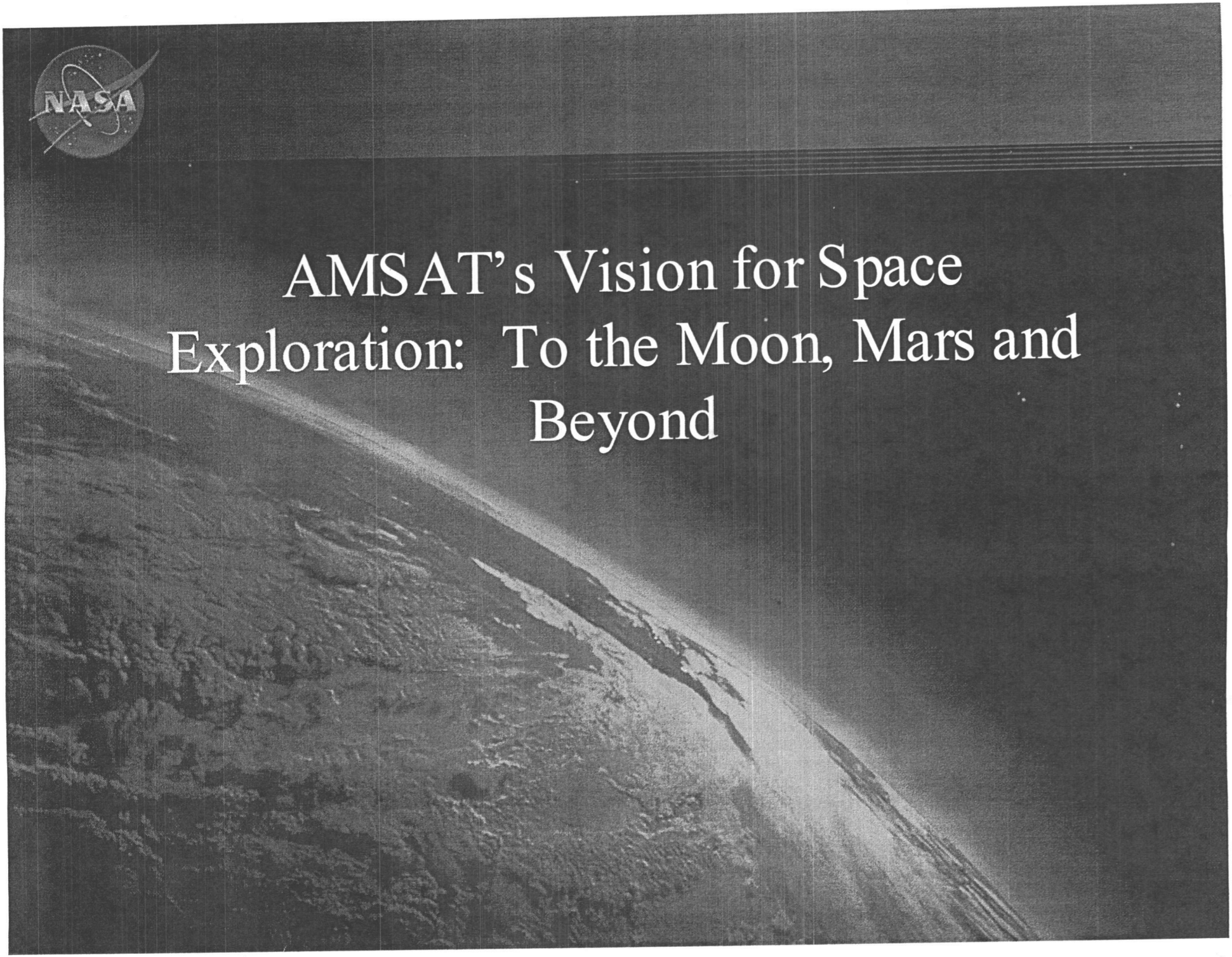


Expedition 12 Potential Plans

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)

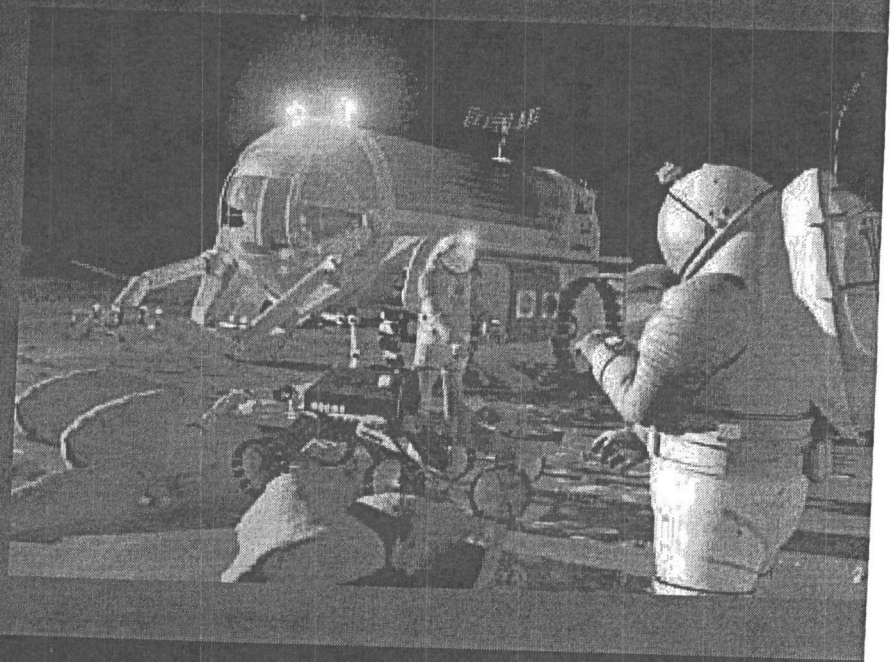

Team Interactions
ARISS International
Rosalie White ARRL
Frank Bauer AMSAT
Debbie Brown Biggs NASA HQ
Amateur Radio Executive Board USA
NASA & Astronaut Amateur Radio Activities
Program Manager-F. Bauer
Deputy Program Manager-M. Steiner
Technical Support Officer-C. Jackson
School Group Operations T. Bosma J. Nickel
Hardware Development L. McFadin
Educational Outreach R. White
General Operations & Troubleshooting K. Ransom
Software Development G. Carman
Crew Training D. Taylor
Public Relations Scott Stevens
ISS Ham/ARISS USA
GSFC Station NN1SS K. Nichols
Astronaut Office Ellen Baker
Payload Integration Manager K. Ransom
School Operations BMEs S. VanderArk
Crew Training
Flight Operations Team
Code CB Education Scott Anderson
Space Station Program Office Interfaces

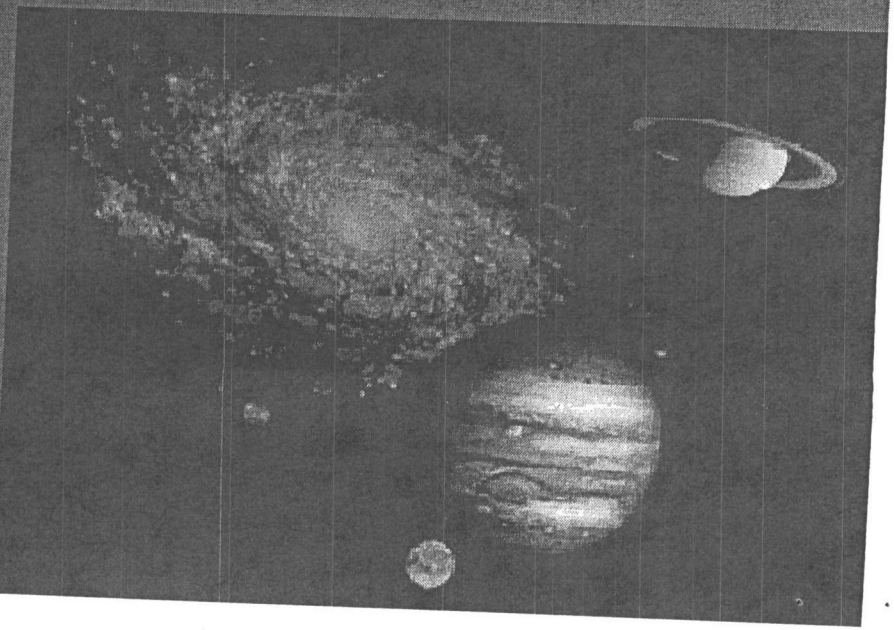


AMSAT's Vision for Space Exploration: To the Moon, Mars and Beyond

Background

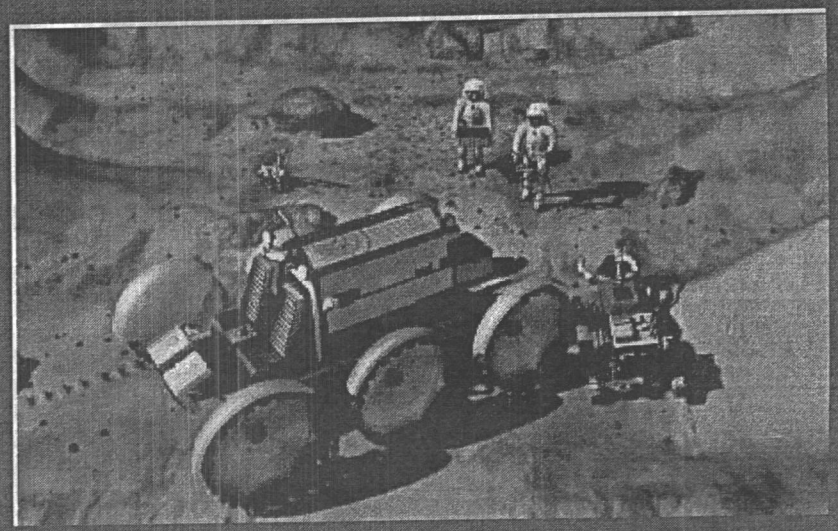
- On January 14, 2004, US President Bush proclaimed a new exploration initiative for NASA---go to the Moon by 2020, Mars next and beyond Mars later
- NASA working on architecture and funding for new initiative
  - Tentative plans include completing ISS development by 2010, ending Shuttle flights by 2010 and re-directing other funding to exploration priorities





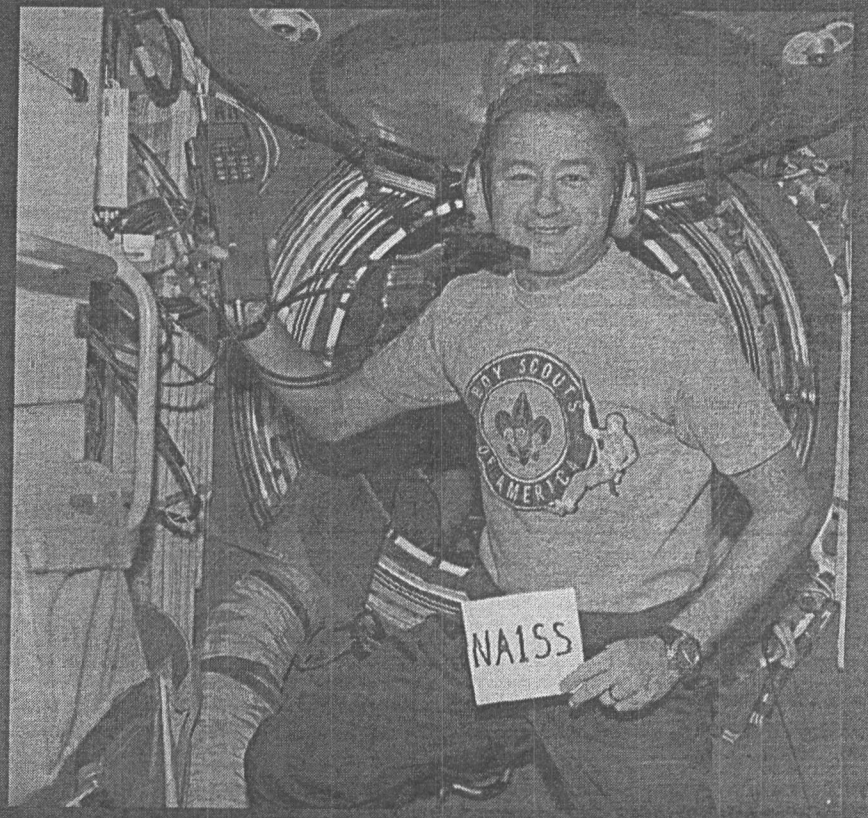
The Future

- 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

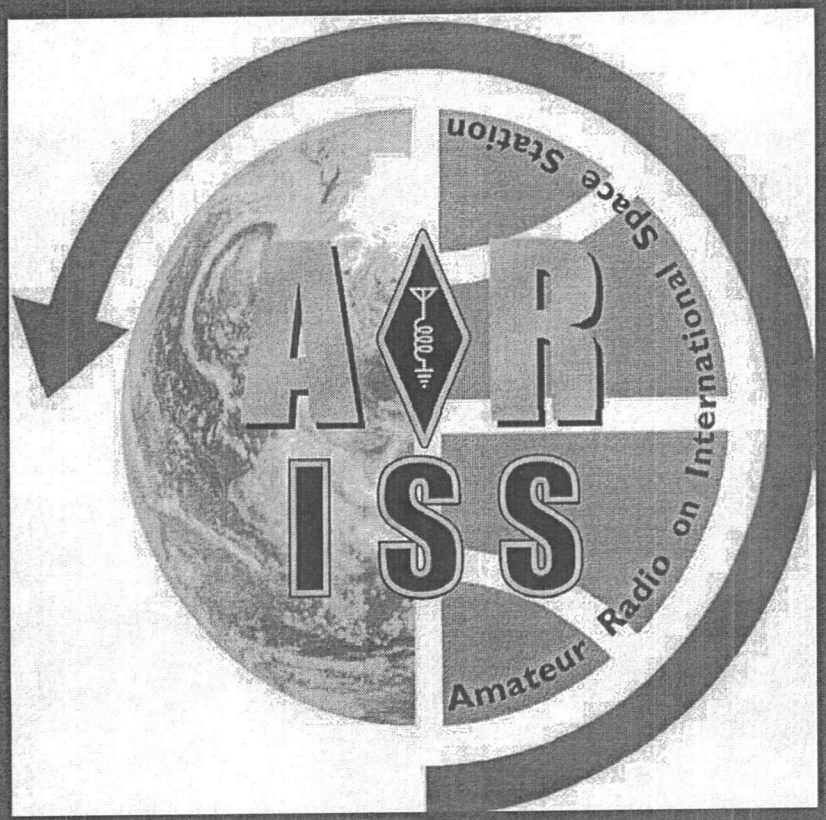
- Phase 1 and a portion of the Phase 2 hardware has been delivered on ISS on 5 launches
- Multi-mode, multi operations capability is now a reality on ISS
- Payload provides an outstanding Educational Outreach foundation for ISS
- ARISS's solid performance and outstanding international teamwork is recognized 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

