

On-Orbit Hardware Status



*ARISS International
Meeting*

ESA ESTEC

March 26, 2004

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HARDWARE DEVELOPMENT PLANS

Development to be conducted in four phases

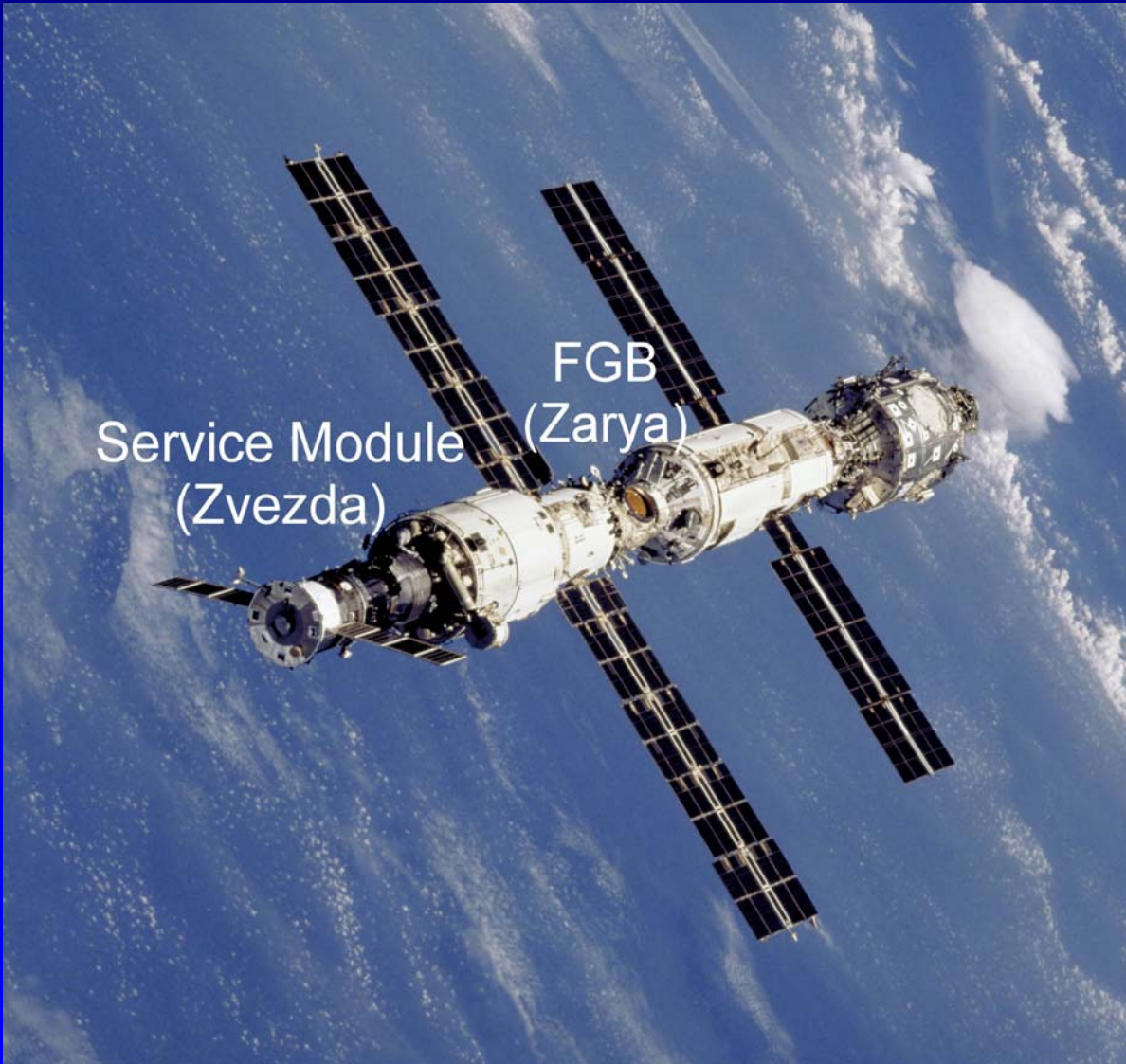
- **Initial Amateur Station (Phase 1 is on-orbit)**
- **Transportable Amateur Station—Phase 2 (Developing/On-Orbit)**
- **Permanent Amateur Station (Future)**
- **Express Pallet/External Experiments (Developing & Future)**

Installation/Launch Status (2000-2001)

4 Launches in 2 Years!!

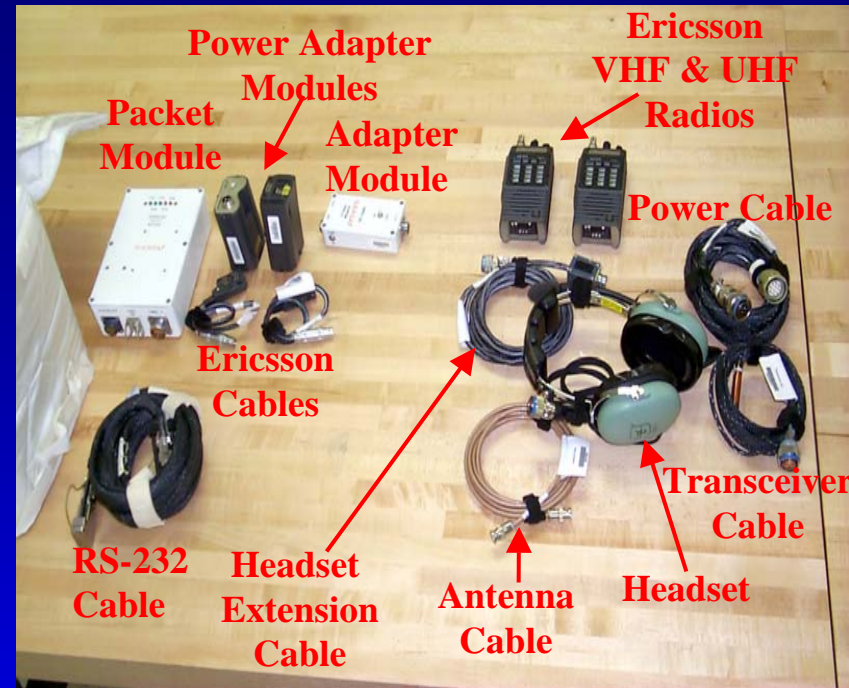
- STS-106 (2A.2B), September 2000
 - delivered Phase 1 VHF & UHF Ericsson radios to ISS
 - VHF FM (144 MHz) radio system installed in Zarya (FGB) & attached to Sirius antenna system
 - Supports voice & packet ops
- Soyuz Flight 2R
 - Increment 1 crew activates VHF equipment on November 13, 2000 (14 days 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

Ham Station Location: Service Module and FGB



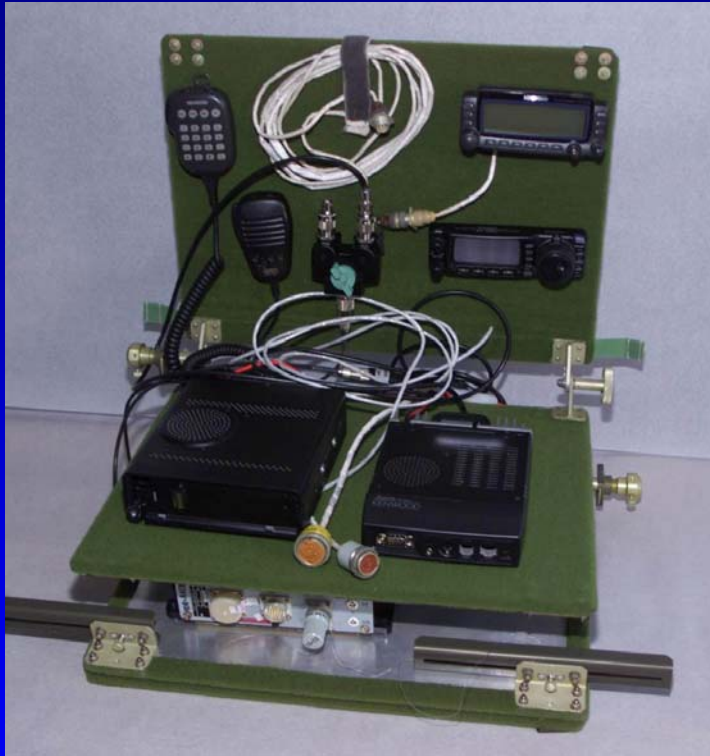
- **Initial ops in FGB**
 - Using Phase 1 VHF radio system
- **Primary ops in Service Module**
 - Multi-mode, multi-operator capability after installation of 4 antenna systems

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 operates for 1-2 orbits after power off
 - Needs to be reset by the crew (waiting for 1.5 years for this)
- Ericsson 70-cm radio awaiting installation in Service Module
- 1 Headset extension cable needs replacement (PTT intermittent)
- 1 Headset brought back instead of headset extension cable
- Preparing headset and extension cable for launch on Progress

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*

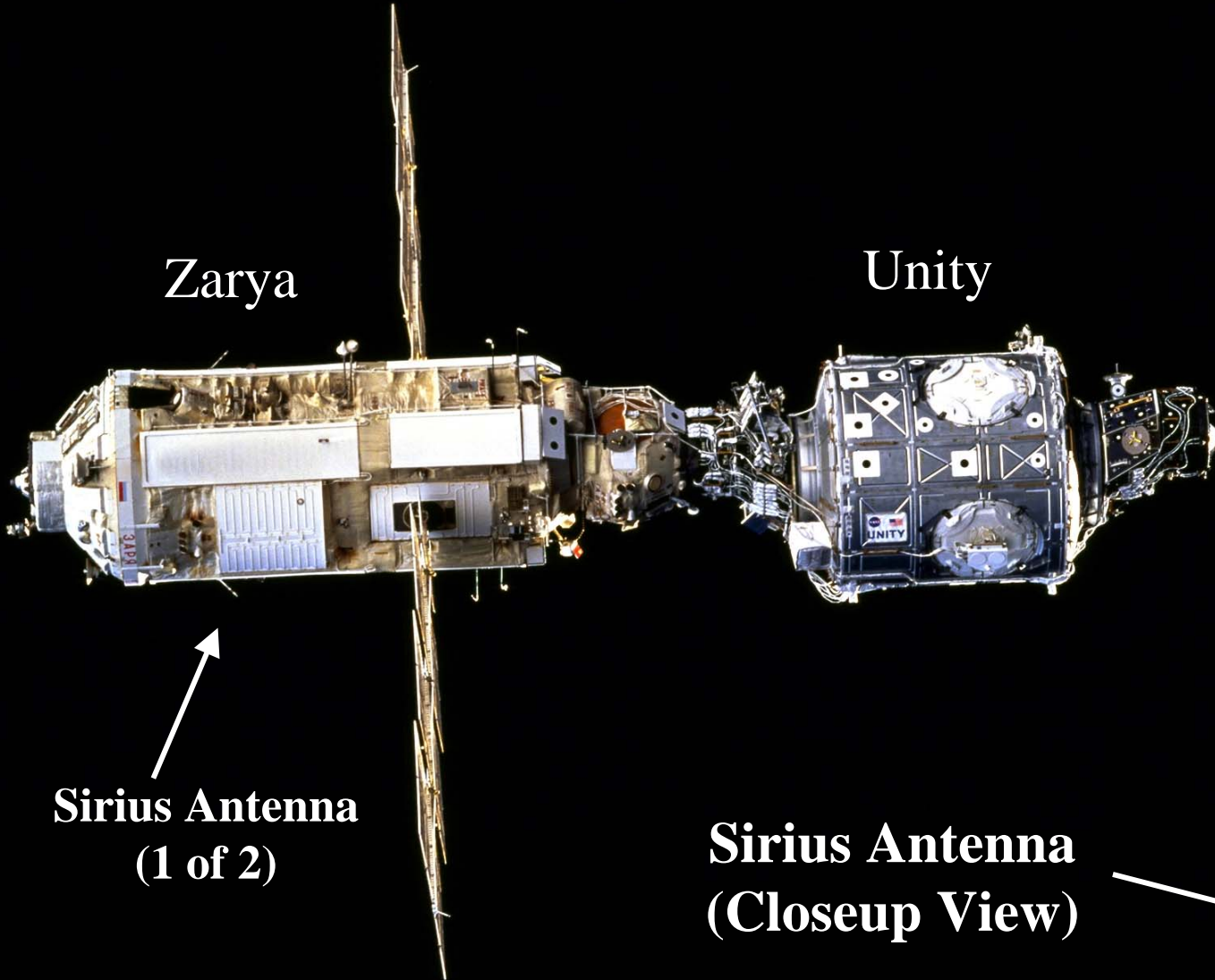
SIRIUS ANTENNA LOCATION ON ZARYA

Zarya

Unity

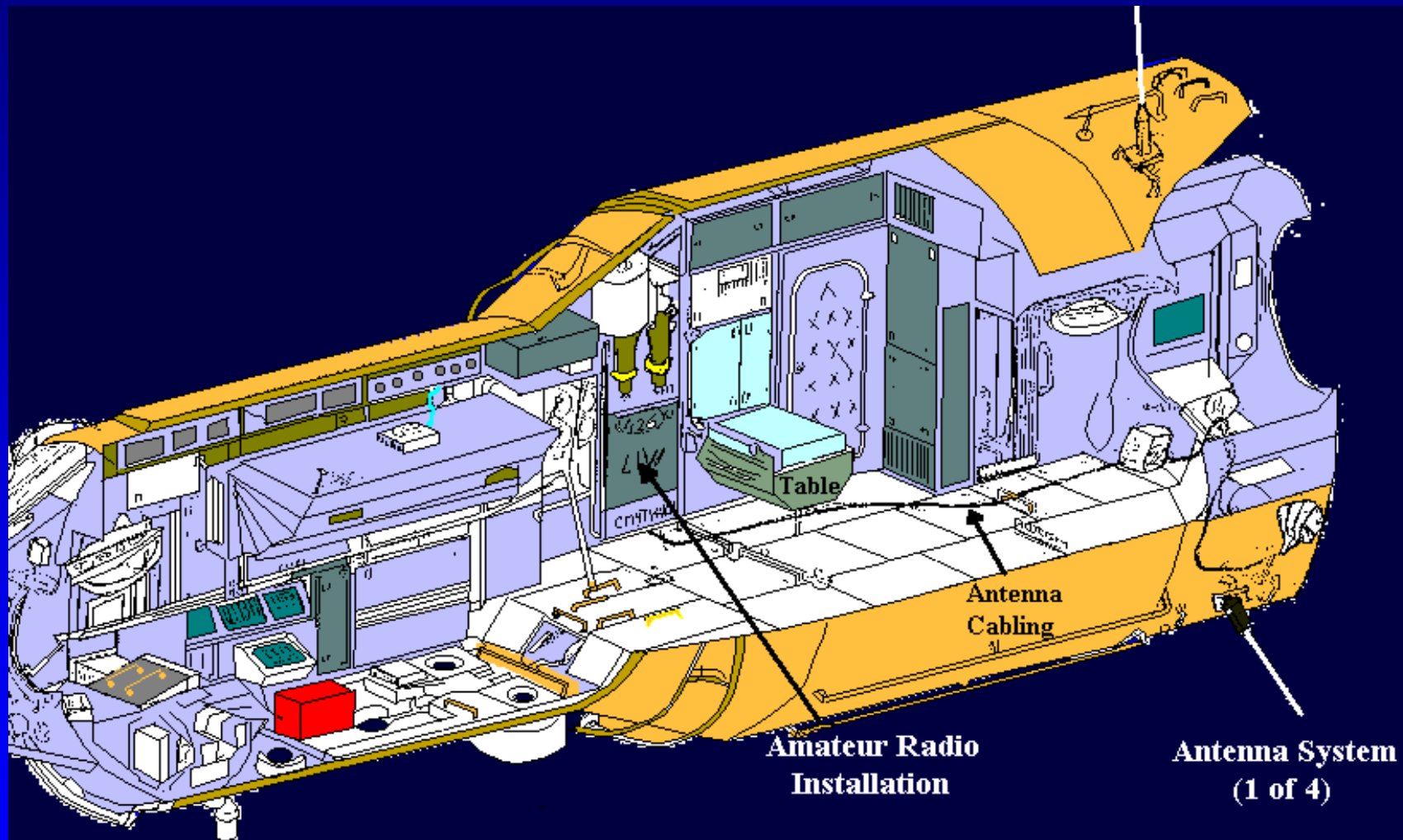
Sirius Antenna
(1 of 2)

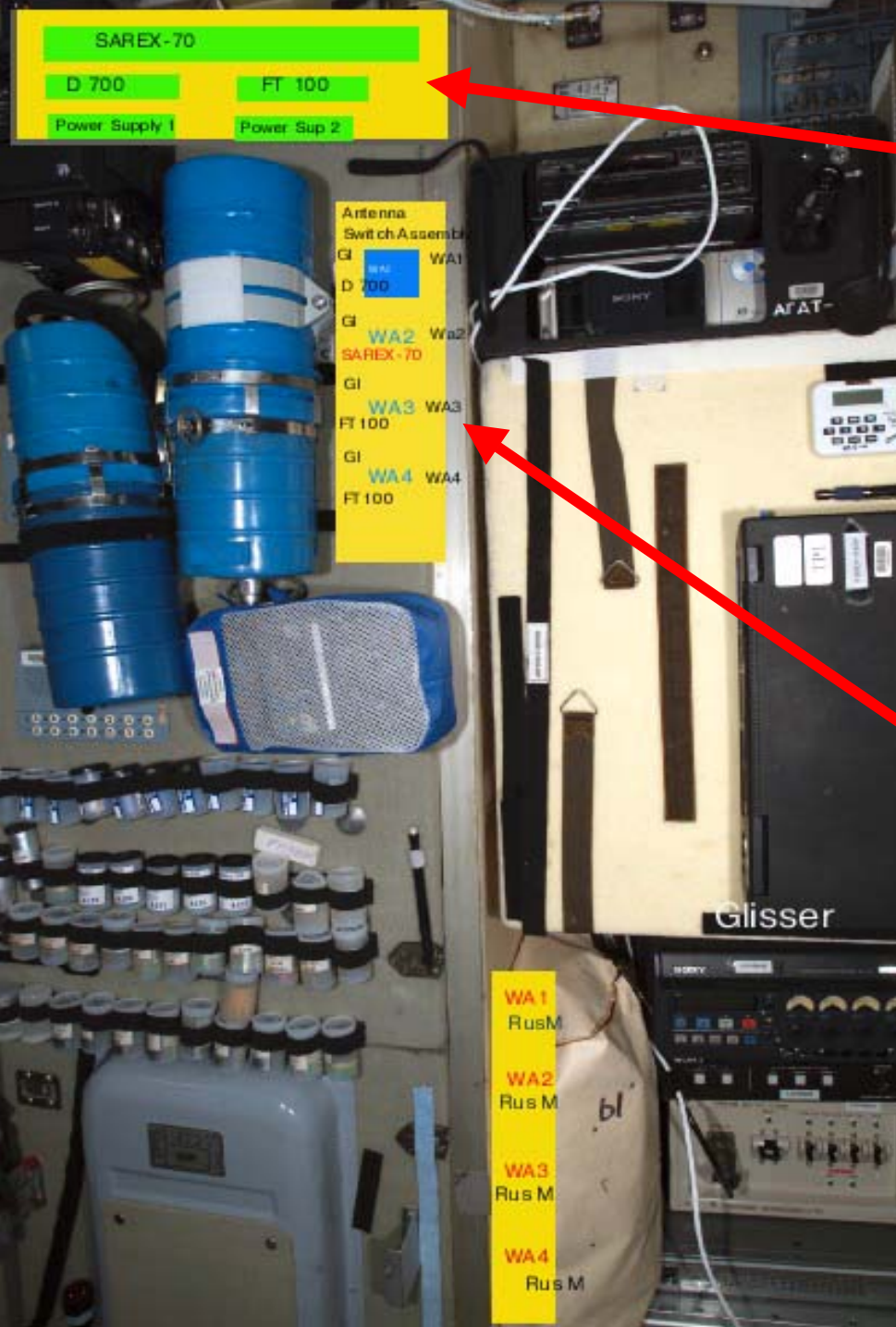
Sirius Antenna
(Closeup View)



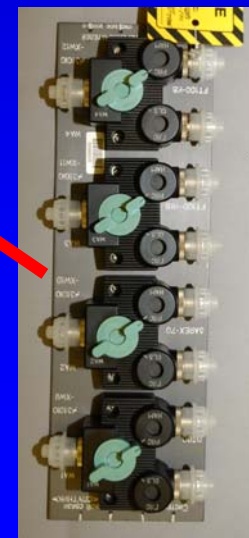
ARISS / ISS HAM

Location in and on the Service Module

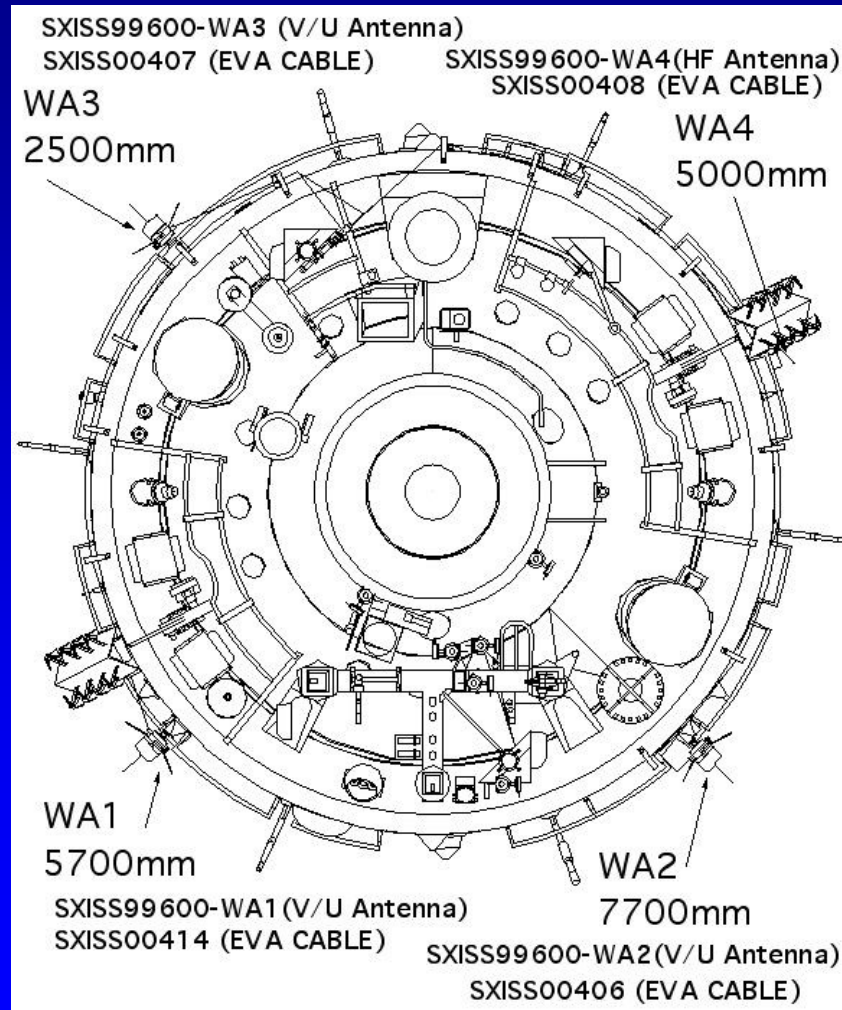




On-Orbit Layout of ISS Ham Equipment in Service Module



Antenna System Installation on Service Module



Antenna System w/ VHF/UHF Antenna Installed

(1 of 4)

Internationally Developed

Italian Contribution:

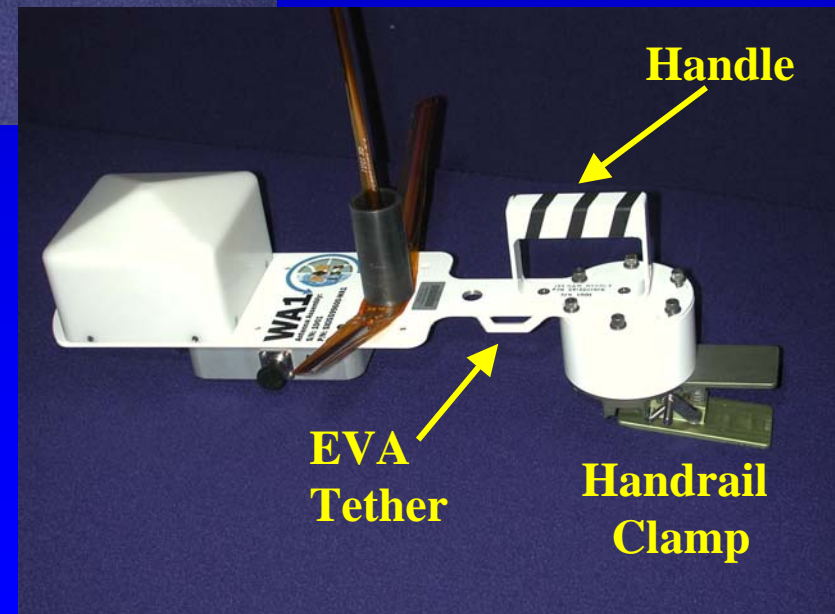
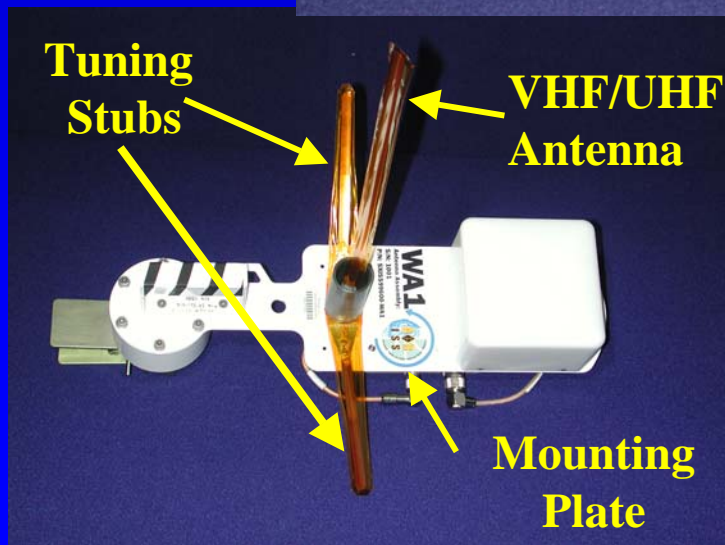
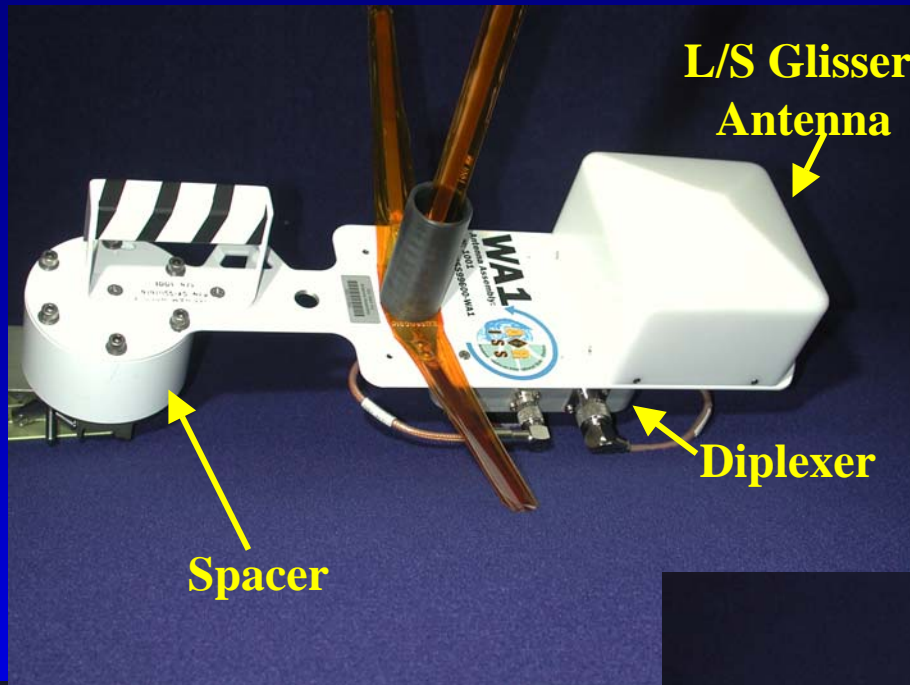
Microwave Antennas
Diplexer

US Contribution:

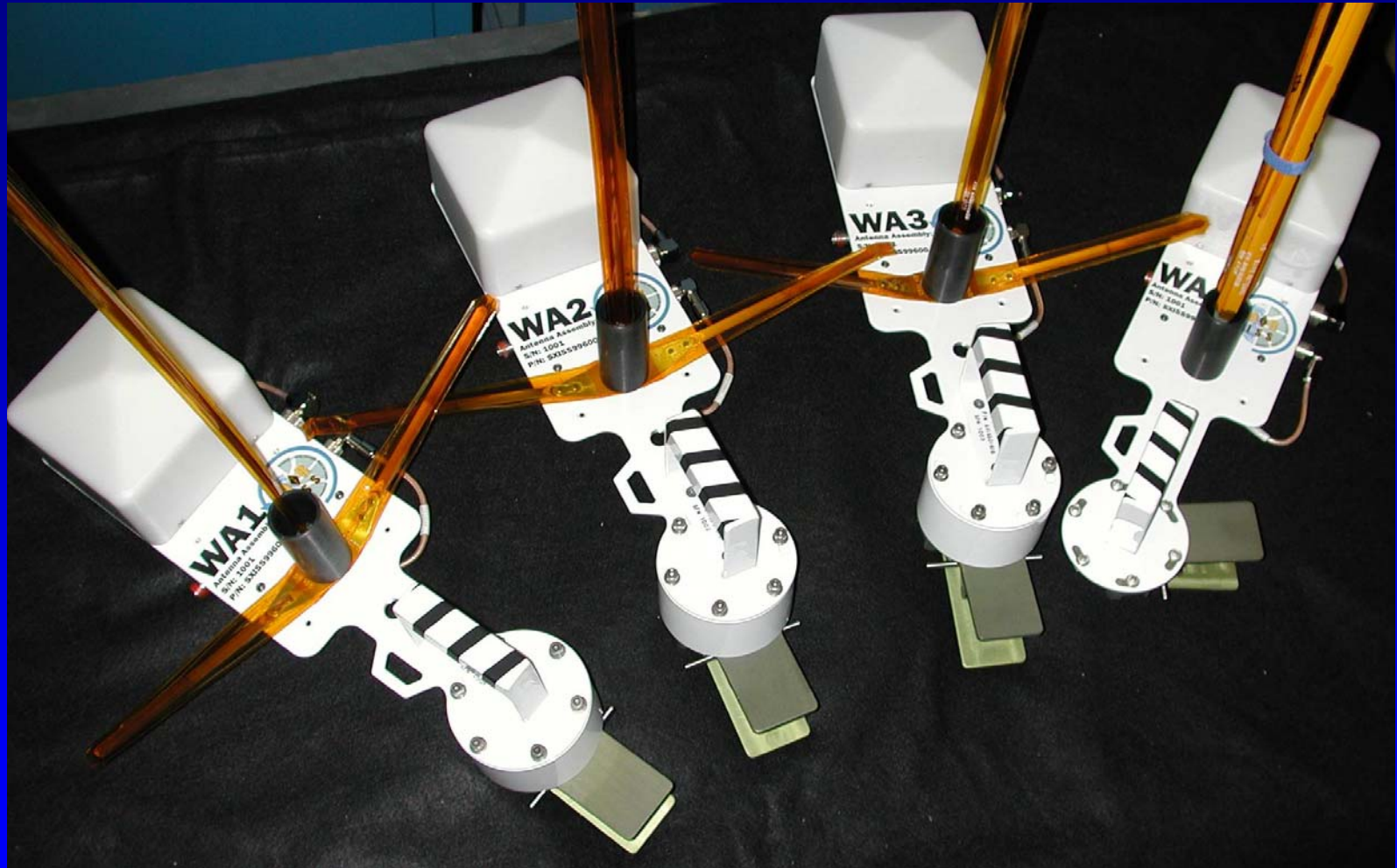
Mounting Plate
Handle & Spacer
VHF/UHF & HF Antennas

Russian Contribution:

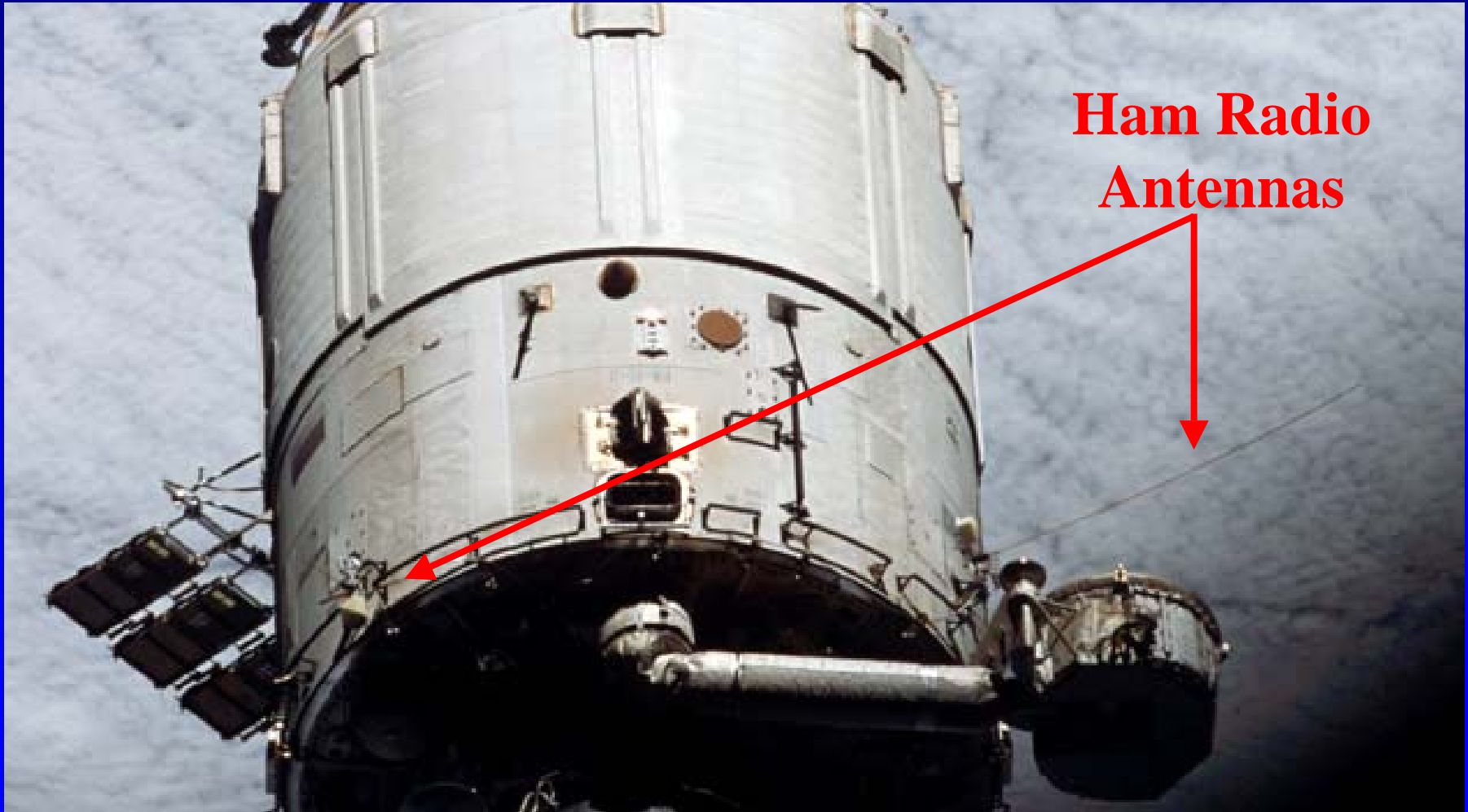
Handrail Clamp
Interconnecting Cables



Antenna Systems WA1-WA4

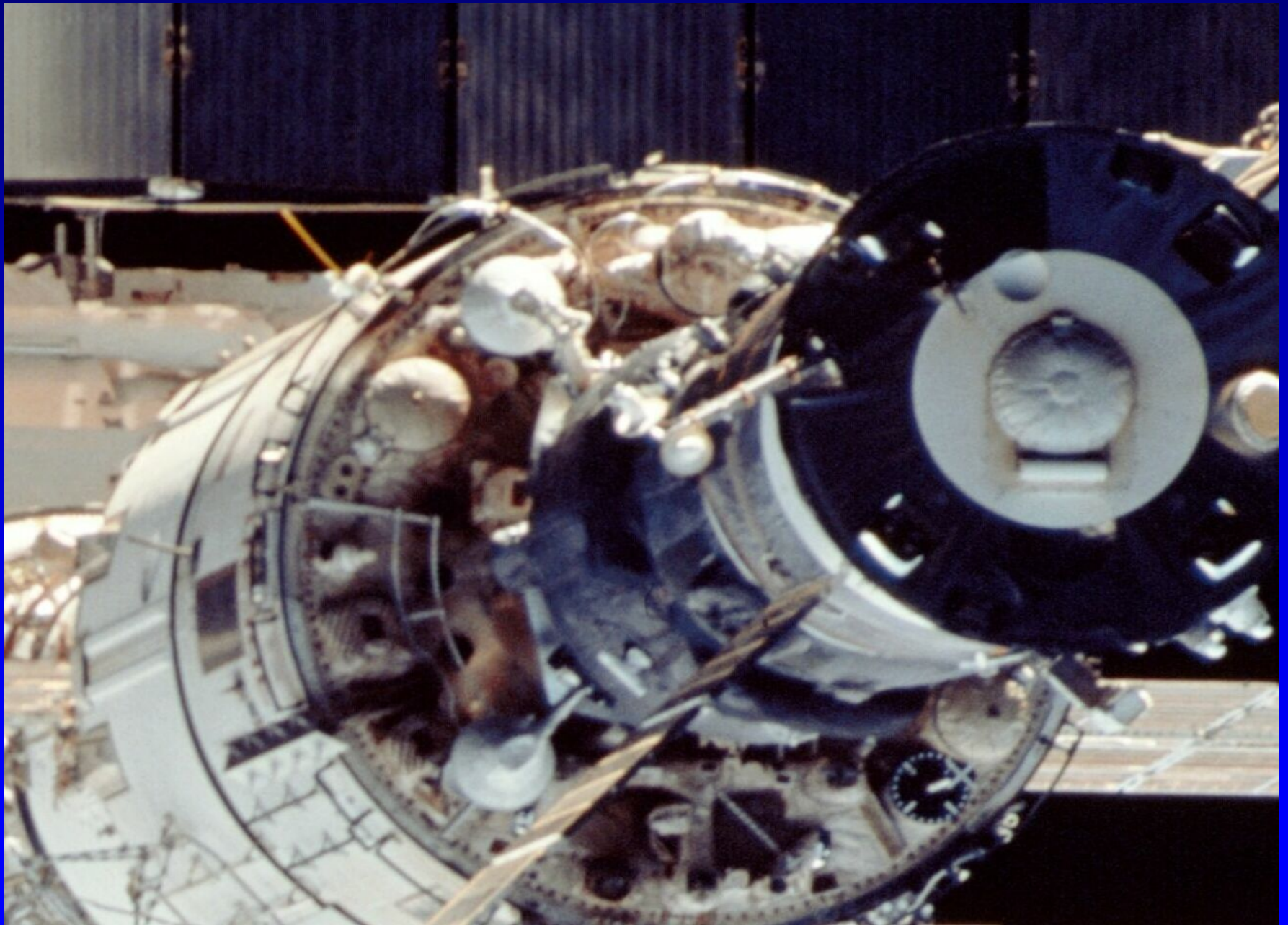


WA3 and WA4 Antennas on Service Module



Ham Radio
Antennas

WA3 Antenna



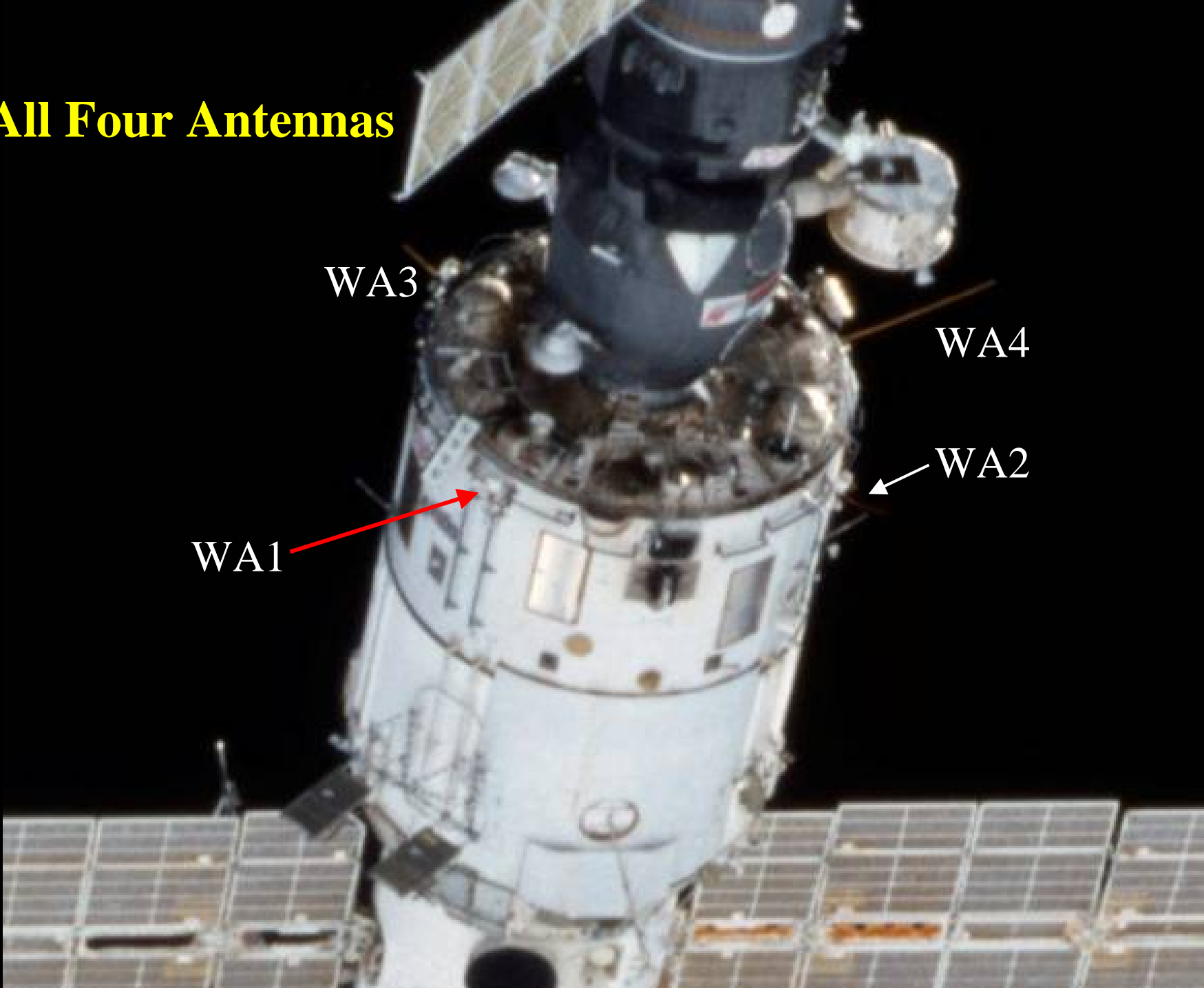
All Four Antennas

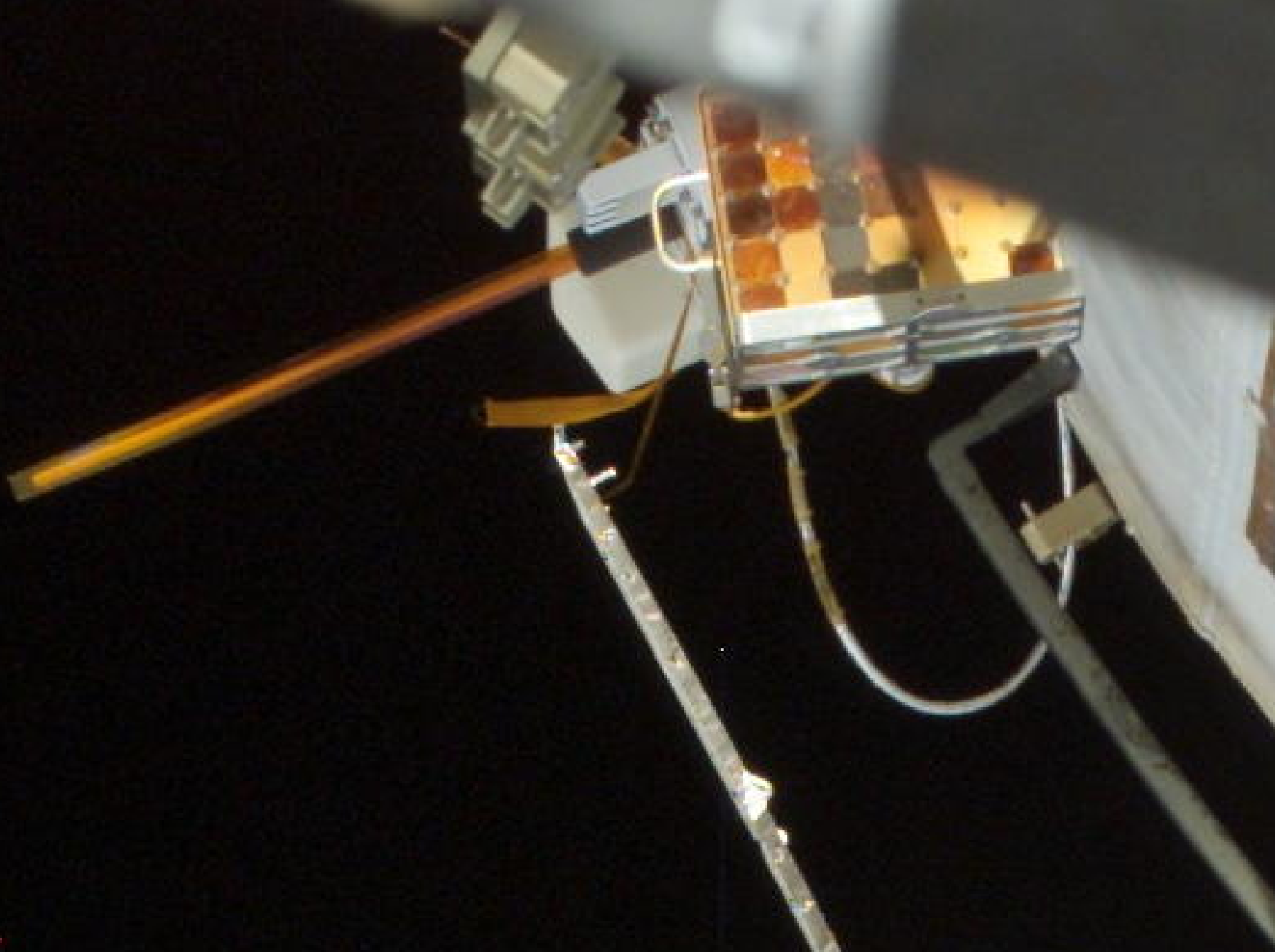
WA3

WA4

WA2

WA1





Installation/Launch Status (2003-2005)

3 Launches in 3 Years!!

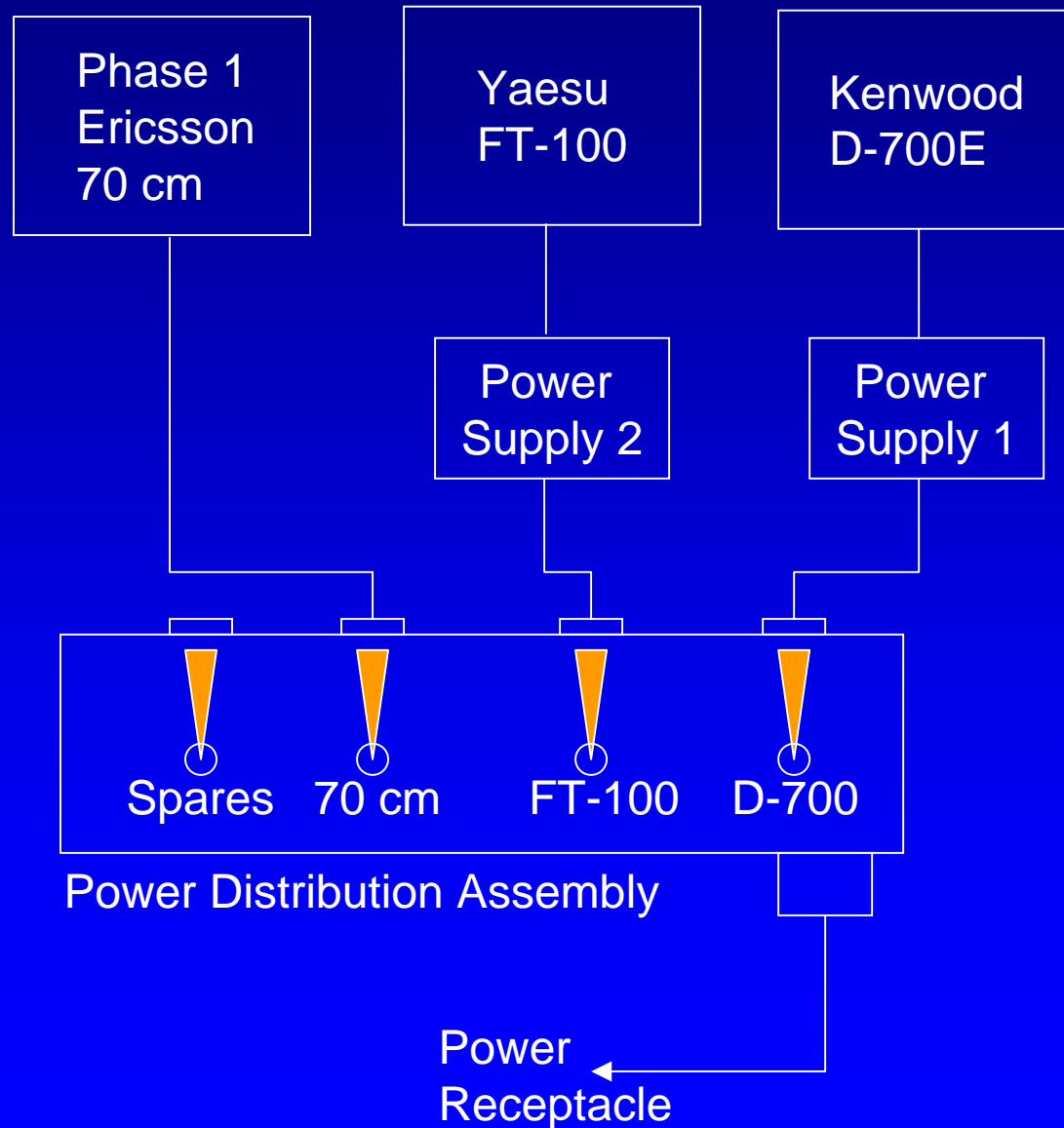
- Progress 12P flight, August 30, 2003
 - Delivered Kenwood D-700E Radio System Hardware to ISS for Phase 2
 - Delivered Energia Power Supplies
- Progress 15P or 16P flight, Late 2004
 - Deliver Yaesu FT-100D Radio System Hardware for Phase 2
 - Deliver SSTV Hardware and Software
 - Deliver Phase 1 Headset & Headset extension cable
- Shuttle Return to Flight, (LF1) Early 2005
 - Deliver MISSE-5/PCSAT2 External Payload



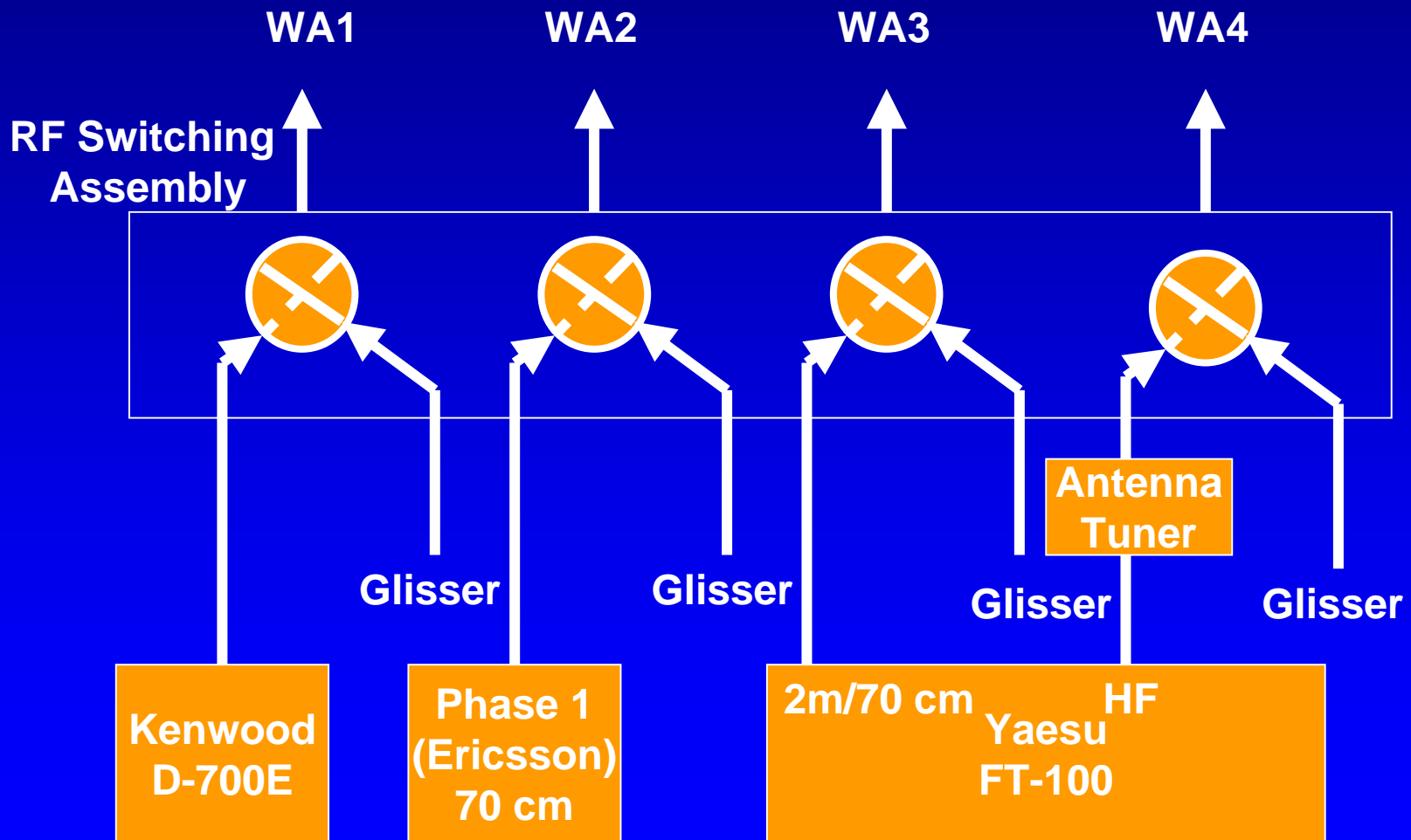
**Progress 12P w/ ISS Ham Hardware
Prepares to Dock with ISS**

Transitioning to Joint Operations in FGB and Service Module

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



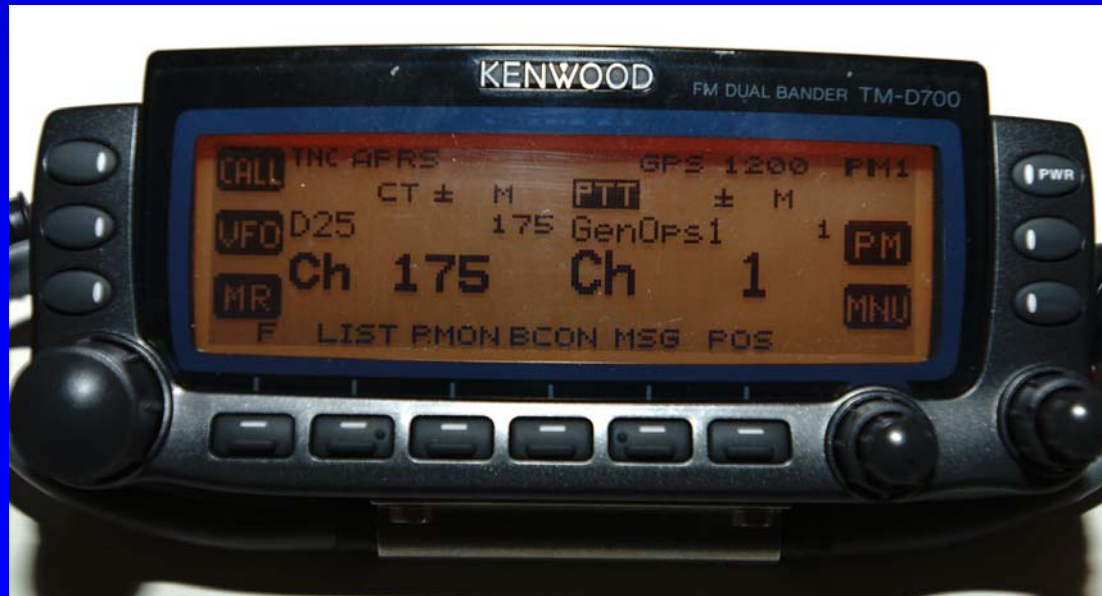
Service Module Antenna Utilization (Phase 1 70 cm and Phase 2)



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



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
 - General voice QSOs
 - Packet
- D700 Russian Engineering Test Pass successfully completed
- Awaiting US Engineering Pass to validate:
 - Use for school group contacts
 - Voice repeater
 - 70 cm operations



Phase 2 Hardware Status



Future Hardware Deployments

- SSTV—Late-2004
- Phase 2 Yaesu hardware—Late-2004
- External payload—1st payload (MISSE-5/PCSAT2)—Early 2005



Yaesu FT-100



SSTV Software



MISSE-5/PCSAT2

Conclusions

- Phase 1 and a portion of the Phase 2 hardware has been delivered on ISS on 5 launches
- Payload provides an outstanding Educational Outreach foundation for ISS
- Phase 2 and SSTV systems will significantly enhance an already outstanding ham radio system
- Multi-mode, multi operations capability is now a reality on ISS



Frank Culbertson During Scout Jamboree on the Air