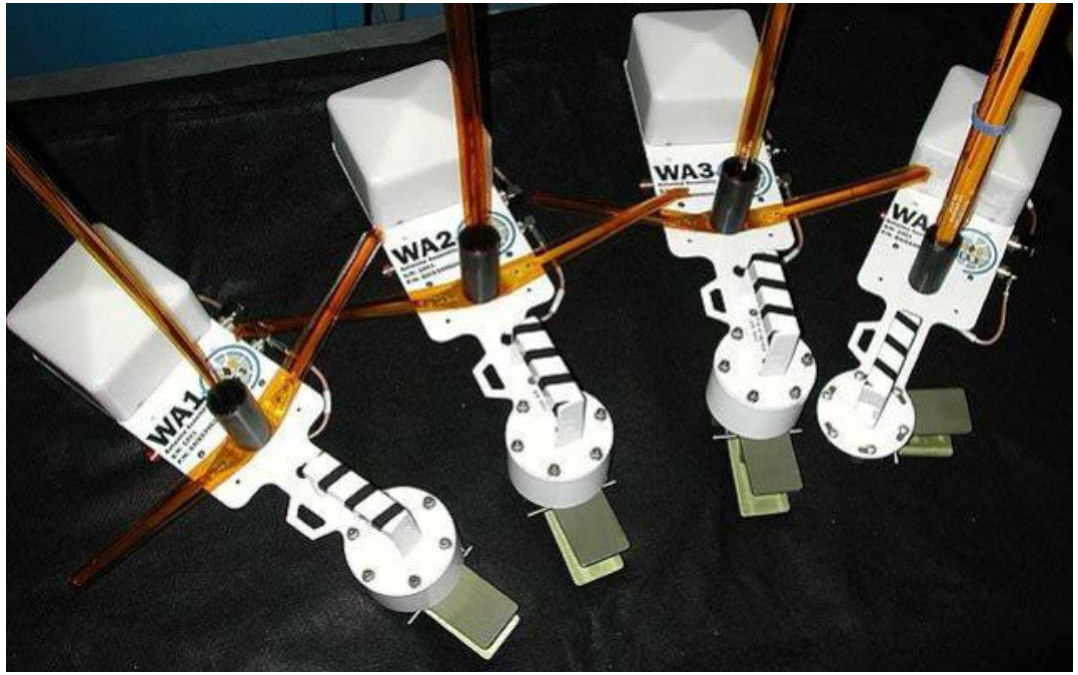
I ***AMSAT Italia ®***

LUNAR GATEWAY AMATEUR RADIO SYSTEM

ARISS International meeting 2024

AMSAT Italia was the main player in the design of various payloads intended for the ISS on-board amateur radio system.

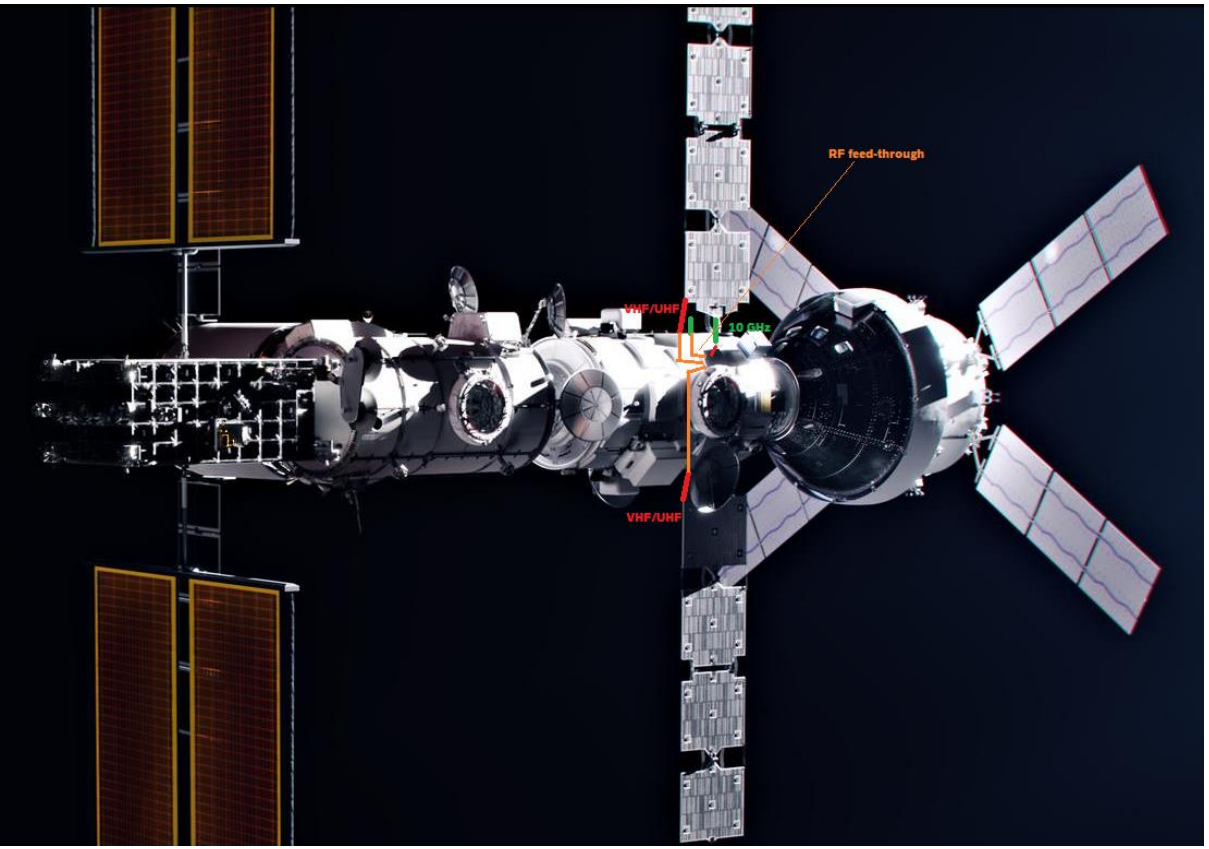


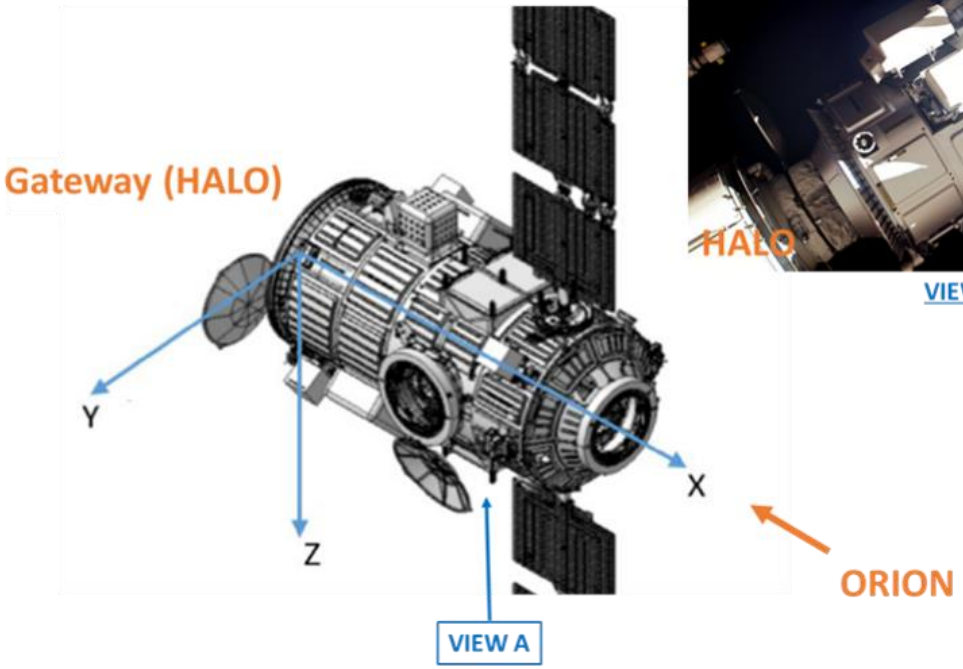
First of all we can mention the design and procurement of four L-S band antennas installed via an EVA on the Russian service module of the ISS

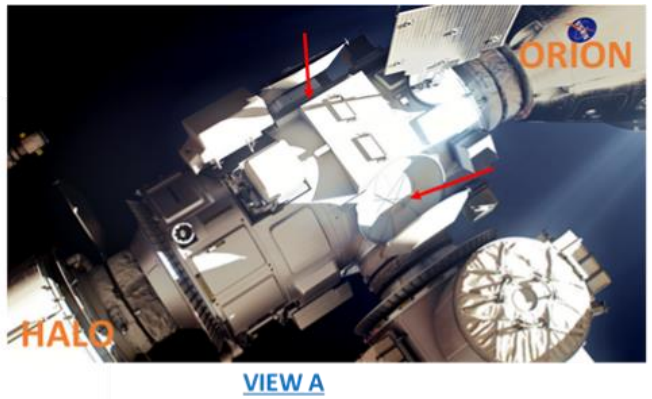
Another important example of experience gained by AMSAT Italia was the design of the amateur radio equipment for the ISS is represented by HAM Video.

Amsat Italia ongoing proposal:

- *Got confirmation that 2 feed through (4 RF Coax) are available on I-HAB current baseline design*
- *Design, procure and install RF cables and antennas before the launch of I-HAB, so that no EVA is required. Of course this will depend on the mass margins available from ESA, if any*
- *Have the 4 antennas connections available inside I-HAB at TBD location*
- *Allow the design of RF units to be delivered at later stage for installation inside I-HAB*







According to nominal GW attitude, Earth will be always in the XY plane +/- 10 deg

Lunar Spectrum Management Portal

Send by email

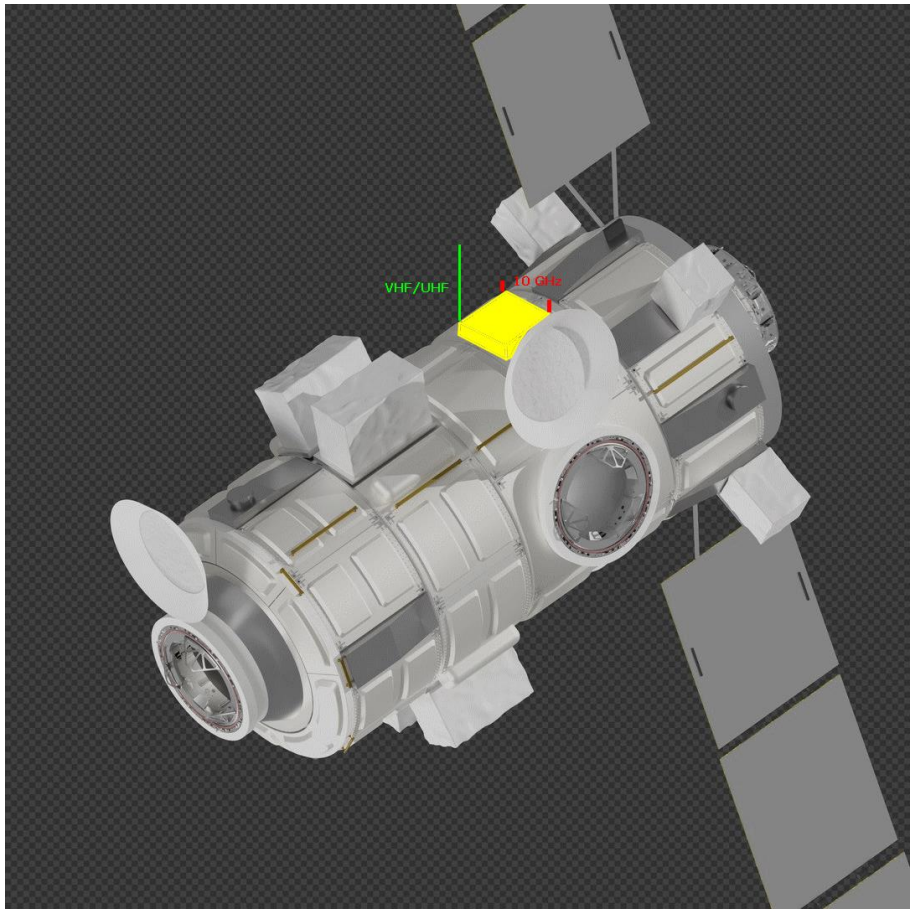
Amateur Radio Operation, Earth-to-Lunar Orbit	144-146	MHz
	435-438	MHz (Note 5)
	2.4-2.45	GHz (Note 5)
	5.65-5.67	GHz (Note 5)
Amateur Radio Operations, Lunar Orbit-to-Earth	144-146	MHz (Note 4)
	435-438	MHz (Note 4), (Note 5)
	10.45-10.5	GHz (Note 5)

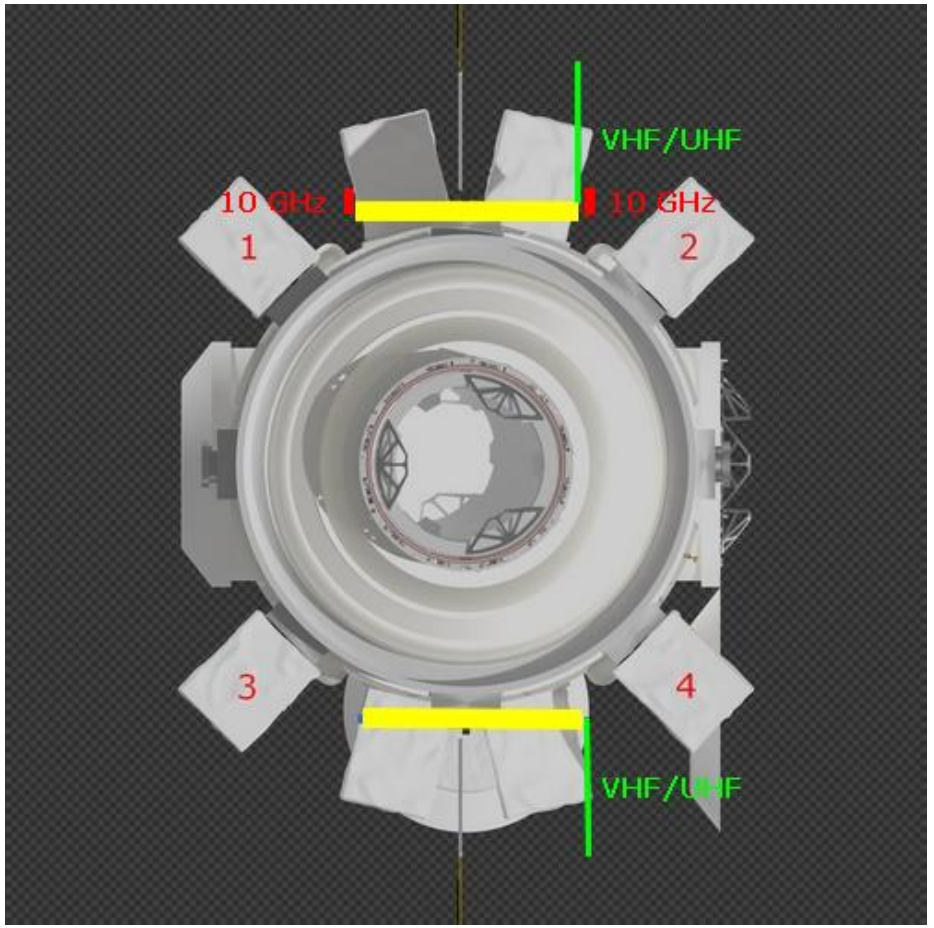
As reported in the Lunar Spectrum

Management Portal and in

Recommendation SFCG 32-2R5

Possible antennas locations on I-HAB, implementation details to be worked out with ESA/TAS-I

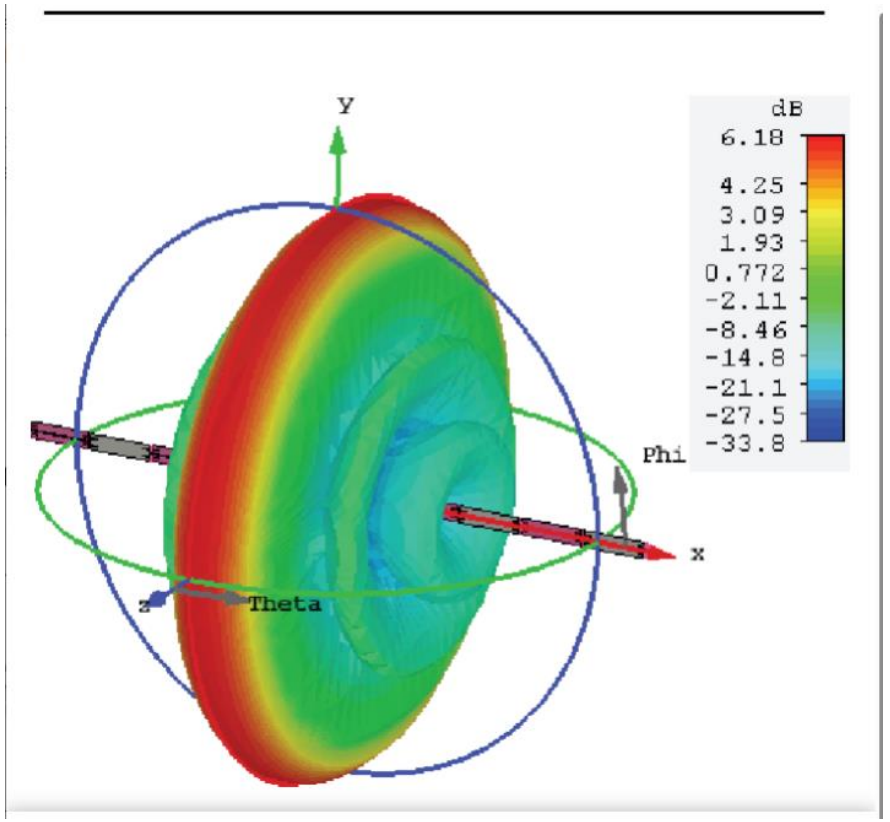




Drivers:
1) keep the 10 GHz antennas as close as possible to the feed-through
2) allocate them to achieve maximum possible coverage

PCB printed dipole array could be the proposed solution, the radiation pattern would allow to cover the Earth from GW in the whole orbit with 2 antennas

Figure 4. Simulated current distribution of the proposed antenna at frequency 1.1GHz.



Preliminary assessment on possible digital voice links has been performed.

DOWNLINK STATION@432MHz

	Assumption				Derived	
	EiRP (dBW)	TX (W)	G/T (1/K)	Tsys (k)	**Required Ant Gain (dBi)**	Antenna Sys
FreeDV 2400	5	3,16	0	600	**28**	8m dish
PSK31	5	3,16	-15	600	**13**	11 el. Yagi
FreeDV 2400	10	10,00	-5	600	**23**	4x19 el. Yagi
PSK31	10	10,00	-20	600	**8**	9 el. Yagi

DOWNLINK STATION@10GHz

	Assumption				Derived	
	EiRP (dBW)	TX (W)	G/T (1/K)	Tsys (k)	**Required Ant Gain (dBi)**	Dish (m)
FreeDV 2400	5	3,16	28	150	**50**	3,50
PSK31	5	3,16	15	150	**37**	0,90
FreeDV 2400	10	10,00	23	150	**45**	2,00
PSK31	10	10,00	10	150	**32**	0,60

Minimum C/N0 required		
voice SSB	+44	Voice over 2500 Hz bandwidth
Enhanced DV	+39	CODEC2 @3000 bps
FreeDV 2400	+35	CODEC2 @1300 bps
PSK31	+21	31 bps
CW	+19	RSCW, 12_wpm
JT65	+10	1.54 bps

C/N_0 dB(Hz)

G/T dB(1/K) \ EIRP dB(W)	+5	+10	+15	+20	+25
+0	8,9	13,9	18,9	23,9	28,9
+5	13,9	18,9	23,9	28,9	33,9
+10	18,9	23,9	28,9	33,9	38,9
+15	23,9	28,9	33,9	38,9	43,9
+20	28,9	33,9	38,9	43,9	48,9
+25	33,9	38,9	43,9	48,9	53,9
+30	38,9	43,9	48,9	53,9	58,9

C/N_0 dB(Hz)

G/T dB(1/K) \ EIRP dB(W)	-5	+0	+5	+10	+15
-20	6,1	11,1	16,1	21,1	26,1
-15	11,1	16,1	21,1	26,1	31,1
-10	16,1	21,1	26,1	31,1	36,1
-5	21,1	26,1	31,1	36,1	41,1
+0	26,1	31,1	36,1	41,1	46,1
+5	31,1	36,1	41,1	46,1	51,1
+10	36,1	41,1	46,1	51,1	56,1

C/N_0 dB(Hz)

G/T dB(1/K) \ EIRP dB(W)	-10	-5	+0	+5	+10
-25	5,7	10,7	15,7	20,7	25,7
-20	10,7	15,7	20,7	25,7	30,7
-15	15,7	20,7	25,7	30,7	35,7
-10	20,7	25,7	30,7	35,7	40,7
-5	25,7	30,7	35,7	40,7	45,7
+0	30,7	35,7	40,7	45,7	50,7
+5	35,7	40,7	45,7	50,7	55,7

Proposed Way forward:

- *Amsat Italia to send this proposal to ESA for approval and authorisation to allow working with the Prime (TAS-I)*
- *Design RF cables routing and antennas and establish Electrical and Mechanical ICDs*
- *Manufacture antennas prototypes and test*
- *Identify a space qualified company to build/qualify the flight antennas*
- *Start working on concept/designs on ICDs within I-HAB and initial RF payloads*
- *International collaboration is more than welcome*