

ARISS HAMTV: Ground Stations and TS Merger

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HAMTV Transmitter

- 2395MHz, 2 watts feed power.
- 2Msps DVB-S (QPSK), FEC ½
- Inputs:
 - NTSC Analogue Video
 - Analogue Audio
- Encoding
 - MPEG-2 Video (1500kb/s)
 - MP2 Audio (64kb/s)



HAMTV Transmitter - History

- 2008 - ESA's Columbus module launched with S- & L-band antennas
- HAMTV Transmitter built & certified for ARISS by Kayser Italia
- 2013 - Transmitter launched to Columbus Module
- March 2014 - First commissioned on ISS
- February 2016 - First used in a HAMTV Contact
 - Used in Tim Peake contacts, then others.
- April 2018 – Transmitter Failed
- January 2019 – Transmitter returned to earth
- March 2024 – Re-launched to ISS
- July 2025 – Installed and powered on!



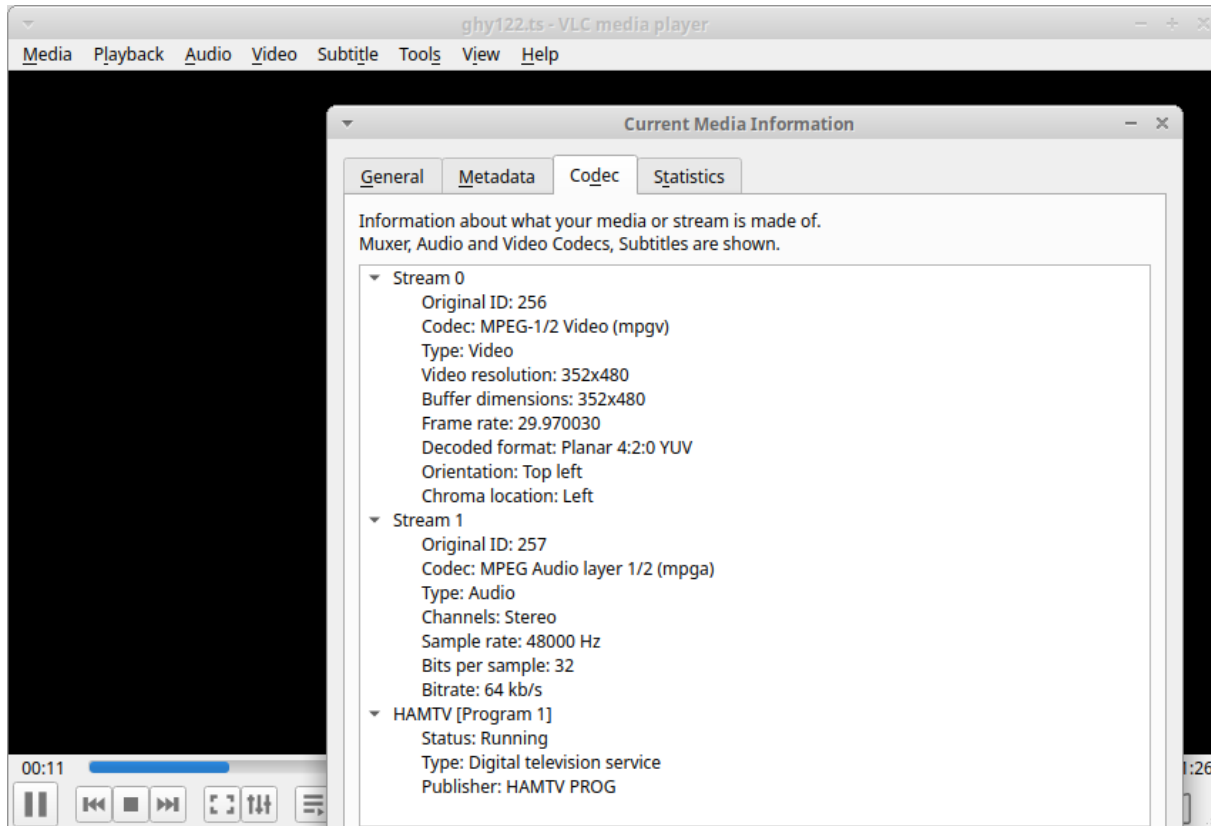
Credit: Sian Cleaver

HAMTV Use

- ARISS Contacts use VHF/UHF FM Voice
 - Although HAMTV has audio, we do not use it in contacts
- HAMTV provides additional facet of live video via Amateur Radio.
- Students can ask for a wave!
- Astronaut can float upside down!
- Technical aspect, can talk about dishes alongside the yagis.

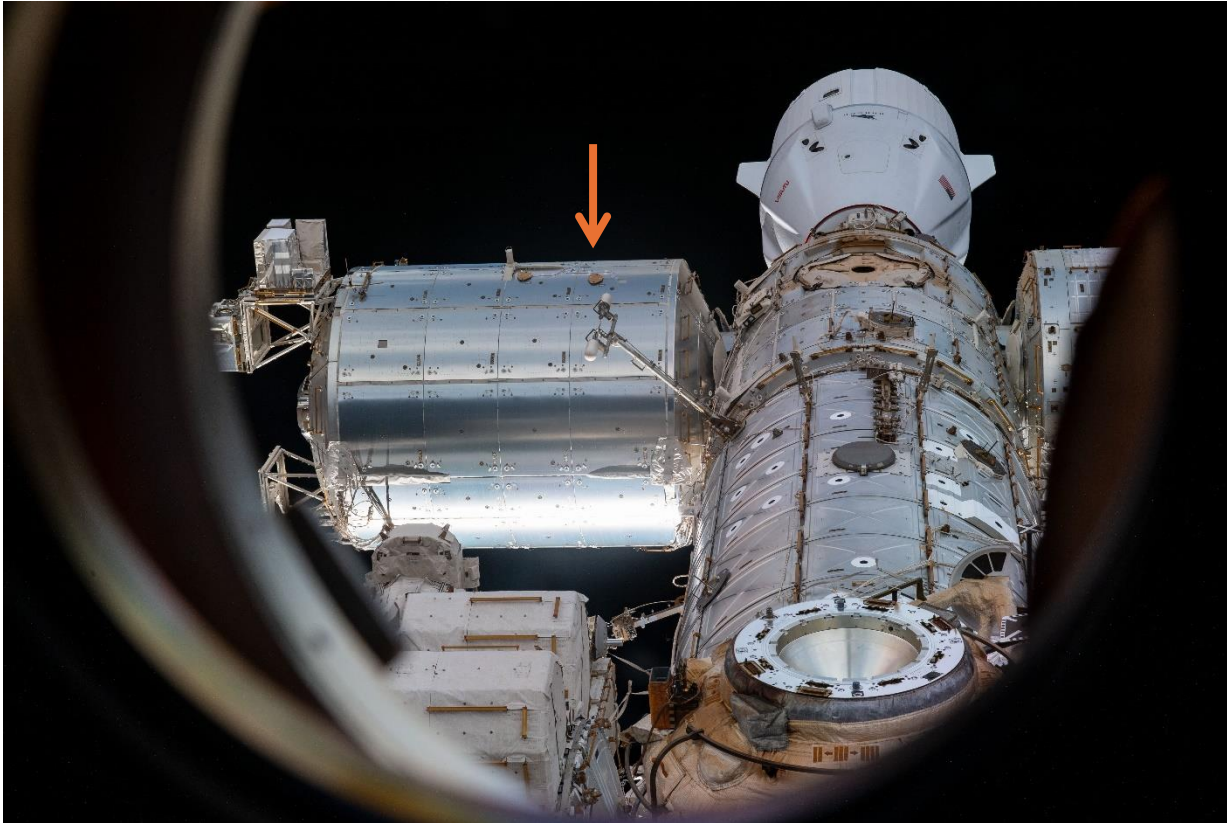


HAMTV Current Transmission



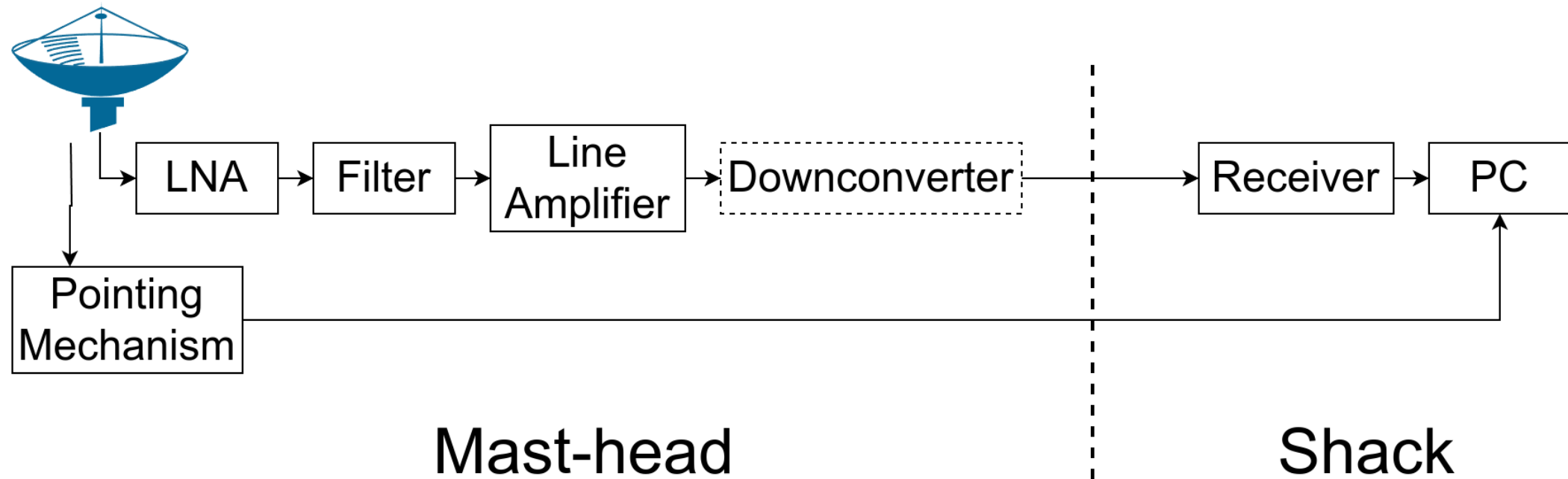
- Transmitter is on!
- Video 'Sync Detection' has been added during repairs.
- Video is 'blanked', audio is muted.
 - No blue line
 - No audio hiss
- Resolution is 352x480 (??!!)
 - Aspect Ratio still 16:9
- We expect camera video to be unchanged from 2017.
 - 854x480

HAMTV Antenna



Photos courtesy of NASA

Ground Station - Overview



Ground Station – Dish size requirements

- Maximising link budget – drives push for large dishes
- In experience: 0.9m @ 90 deg El: MER of 12dB+ (1.7dB required)
- 45° Elevation: 550km, -3dB (+7dB margin)
- 30° Elevation: 740km, -5dB (+5dB margin)
- 20° Elevation: 1000km, -8dB (+2dB margin)
- 10° Elevation: 1440km, -11dB (Negative margin)



Ground Station – Pointing



- 3dB BW:
 - 0.6m: $\pm 7^\circ$
 - 0.9m: $\pm 4.5^\circ$
 - 1.2m: $\pm 3.5^\circ$
- G-5500: “ $\pm 4\%$ ”: **$\pm 14.4^\circ$**
 - Usable with careful calibration

Ground Station - System Noise Figure



LaNA: 2dB Noise Figure, 12dB Gain

Ham It Down: 12dB Noise Figure, 0dB Gain

(Cabling): 2dB Loss

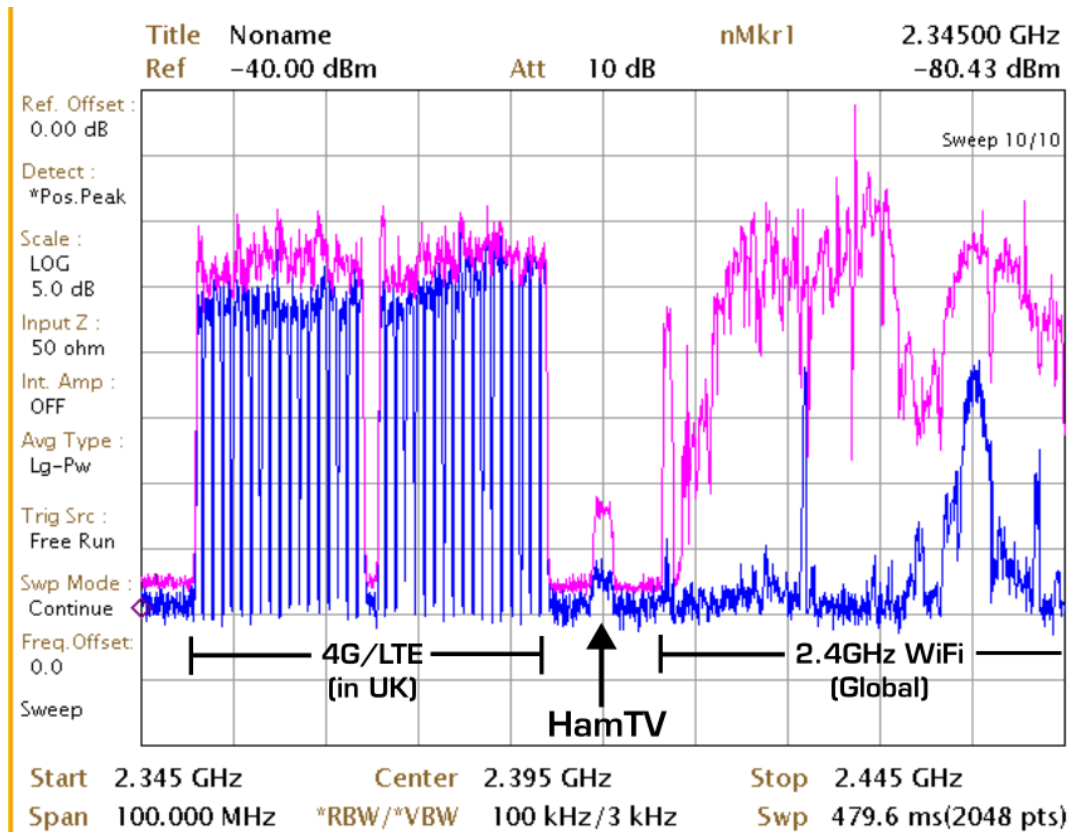
RTL-SDR: 6dB Noise Figure

System Noise Figure: **5.2dB !**

Intermediate gain stage required.

e.g. Cheap 5dB NF, 20dB gain “LNA” before Ham It Down = 2.4dB System NF

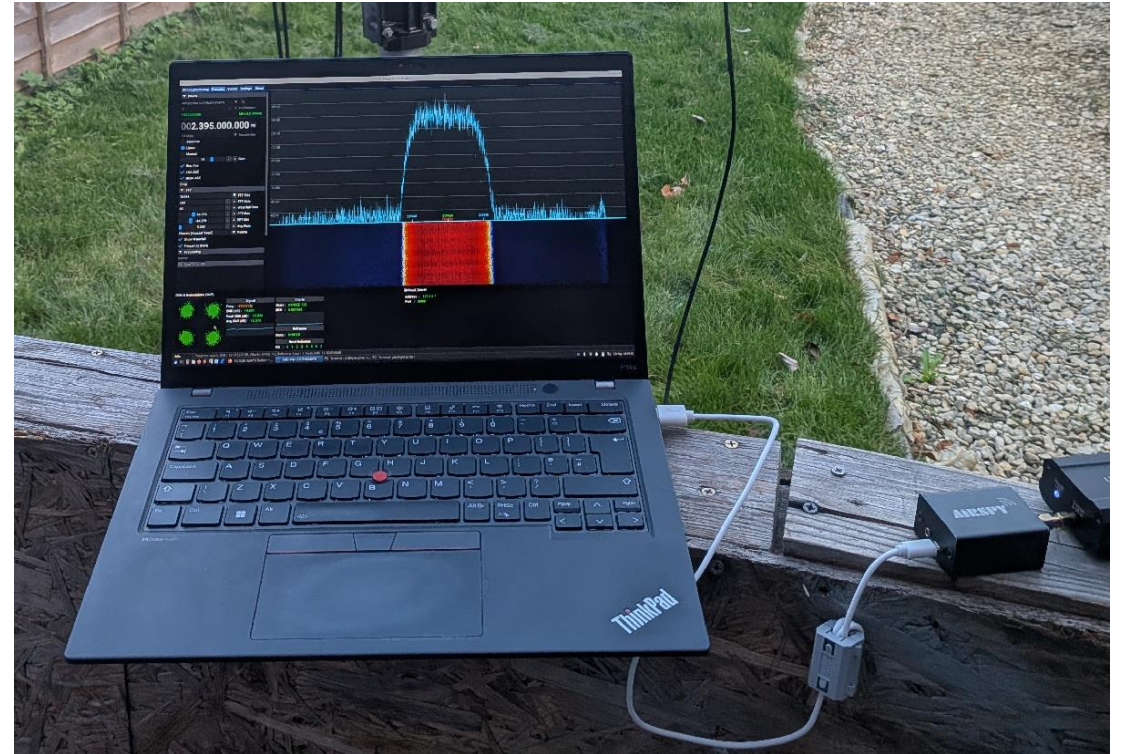
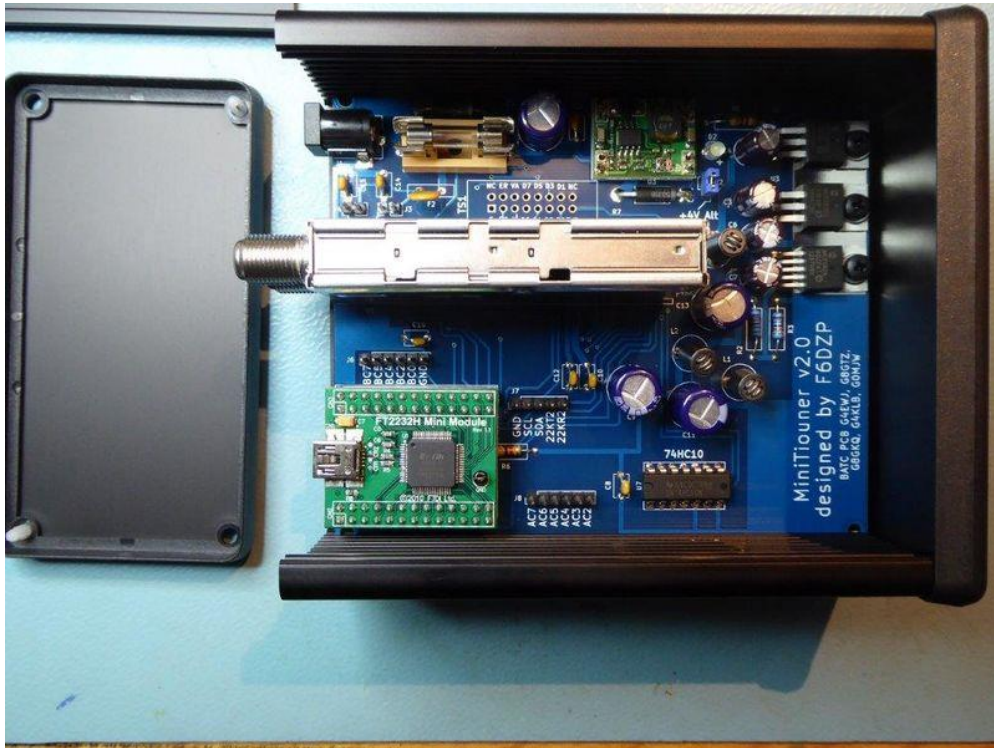
Ground Station – RFI



RX Spectrum of Graham G8FXB

- WiFi Channel 1
 - 2401-2423 MHz
 - Intermittent power peaks
- UK 4G Band 40 - Telefónica
 - 2350-2390 MHz
 - High power density
- Very high system dynamic range required.

Ground Station - Receivers



Ground Station - Examples



M0DNY
0.9m



IK1SLD
1.2m



G8GKQ (2015)
0.6m



Goonhilly
5m

HAMTV Operational Use – Educational Contacts



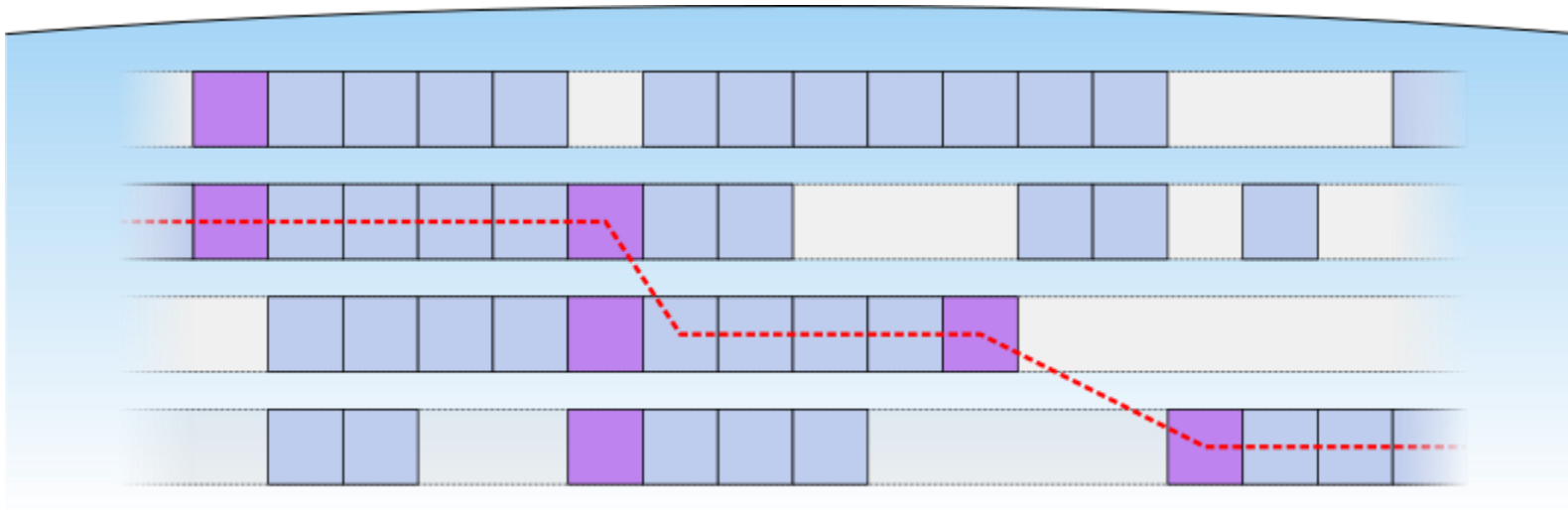
- Venue station set up in 24 hrs
 - Pointing Calibration
 - RFI – WiFi, etc.
 - .. and standard portable station challenges (cables, connectors, rain, etc.)
- Need to ensure that participants get the HAMTV experience during the contact.

HAMTV Operational Use – Manual Switching

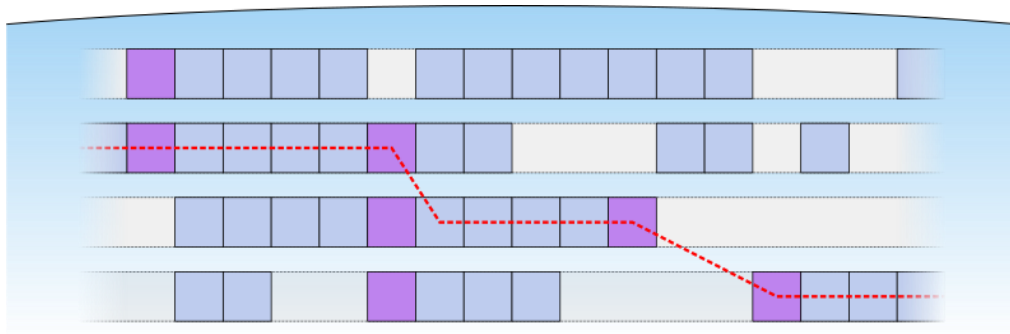


- Assembled by Noel G8GTZ
- RTMP stream per ground station
- Manual switching (close one, open another)
- 6 partial streams = partial stream at best

MPEG-TS Real-time Merging

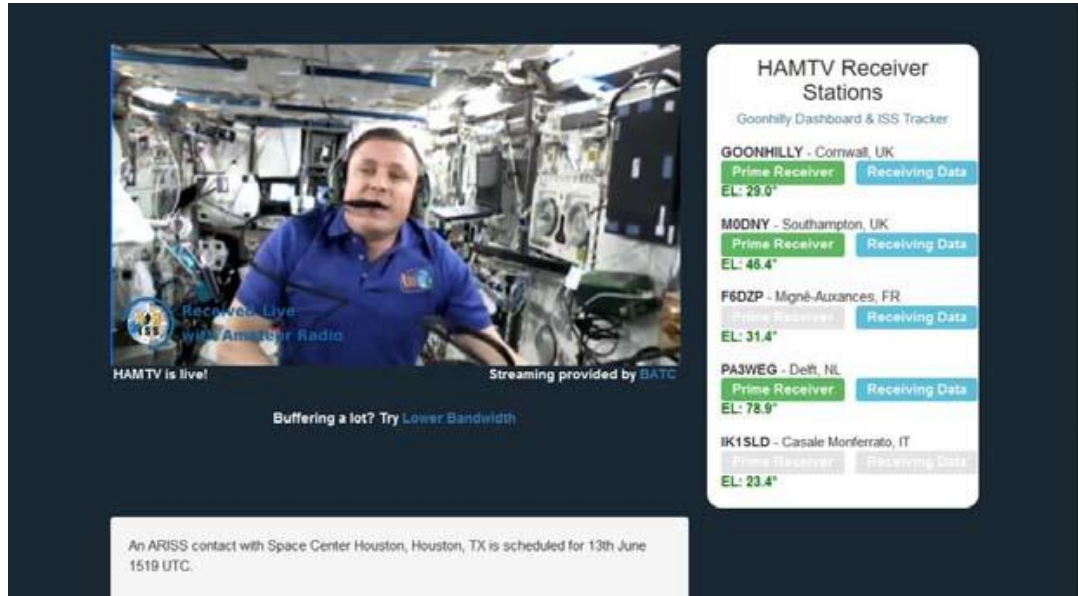


MPEG-TS Real-time Merging



- MPEG-TS is packetised
 - 188 Byte Packets
- Some packets have PCR timestamp ($\sim 1/50$)
- PCR is used to synchronise ground station feeds
- 100ms delay to aggregate data from stations with variable ISP delay
- The earliest PCR segment is copied to output, and displayed

HAMTV TS Merger in Use



The screenshot displays the HAMTV interface. On the left, a live video feed shows a person in a blue shirt and headset. Below the video, text reads "HAMTV is live!" and "Streaming provided by BATC". A message at the bottom states: "An ARISS contact with Space Center Houston, Houston, TX is scheduled for 13th June 1519 UTC." On the right, a panel titled "HAMTV Receiver Stations" lists several stations with their locations and status.

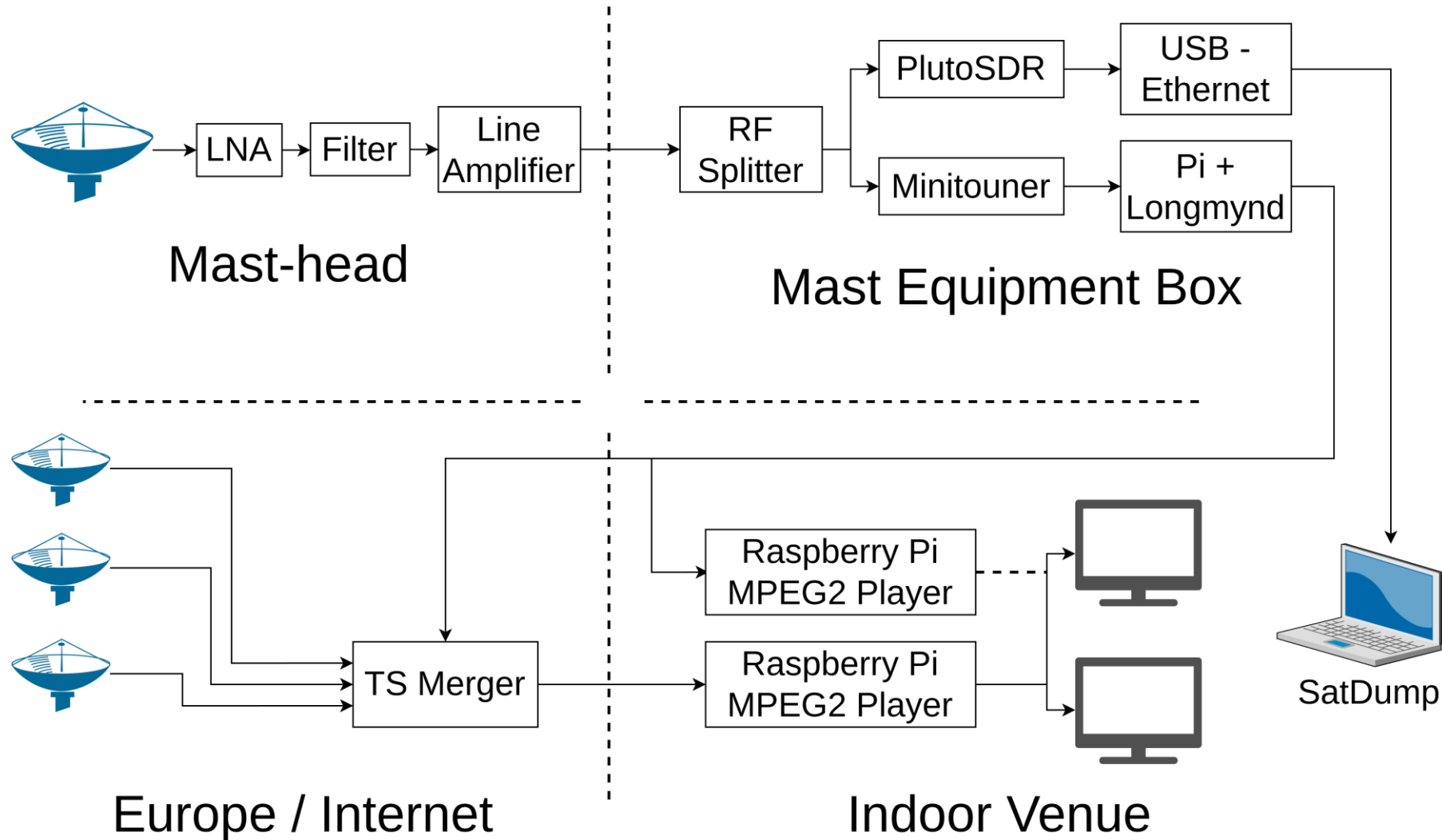
HAMTV Receiver Stations	
Goonhilly Dashboard & ISS Tracker	
GOONHILLY - Cornwall, UK	
Prime Receiver	Receiving Data
EL: 29.0°	
MOONNY - Southampton, UK	
Prime Receiver	Receiving Data
EL: 46.4°	
F6DZP - Migné-Auxances, FR	
Prime Receiver	Receiving Data
EL: 31.4°	
PA3WEG - Delft, NL	
Prime Receiver	Receiving Data
EL: 78.9°	
IK1SLD - Casale Monferrato, IT	
Prime Receiver	Receiving Data
EL: 23.4°	



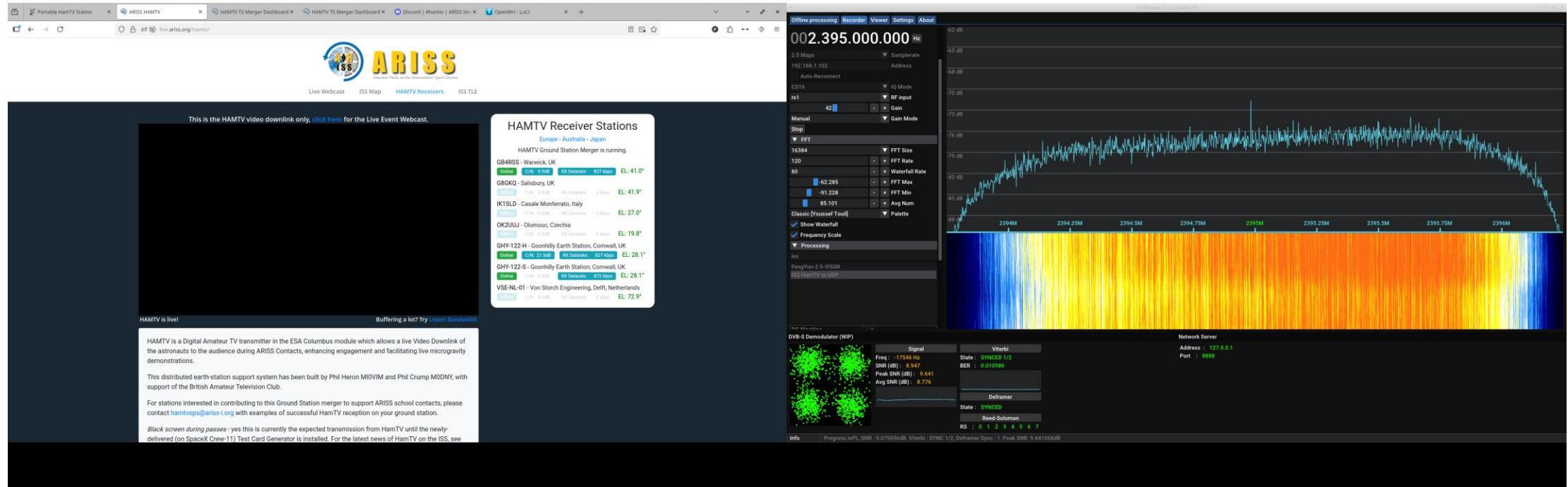
HAMTV – Antenna at Warwick Contact



HAMTV – System at Warwick Venue




HAMTV – Reception at Warwick Venue



HAMTV – Display at Warwick Contact




HAMTV – Contributors to Warwick Contact



ARISS
Amateur Radio on the International Space Station

Live Webcast ISS Map **HAMTV Receivers** ISS TLE

This is the HAMTV video downlink only, [click here](#) for the Live Event Webcast.



HAMTV is live! Buffering a lot? Try [Lower Bandwidth](#)

HAMTV is a Digital Amateur TV transmitter in the ESA Columbus module which allows a live Video Downlink of the astronauts to the audience during ARISS Contacts, enhancing engagement and facilitating live microgravity demonstrations.

This distributed earth-station support system has been built by Phil Heron MIOVIM and Phil Crump MODNY, with support of the British Amateur Television Club.

For stations interested in contributing to this Ground Station merger to support ARISS school contacts, please

HAMTV Receiver Stations

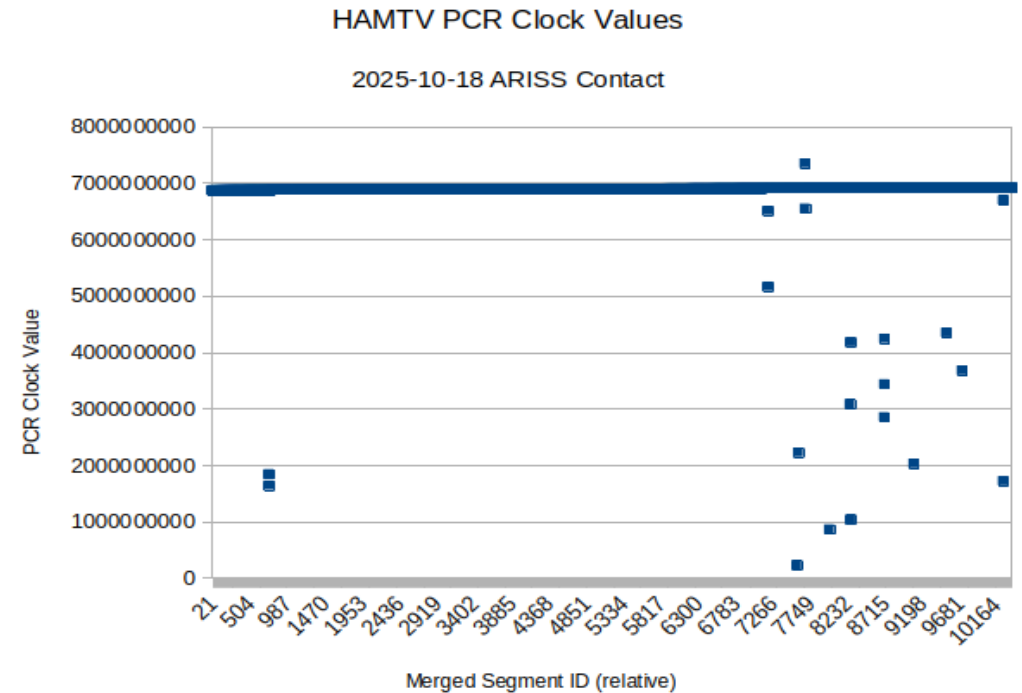
Europe - Australia - Japan
HAMTV Ground Station Merger is running.

GB4RSS - Warwick, UK	Online	C/N: 0.0dB	RX Datarate: 0 kbps	EL: 26.2°
G8GKQ - Salisbury, UK	Online	C/N: 9.6dB	RX Datarate: 842 kbps	EL: 30.6°
IK1SLD - Casale Monferrato, Italy	Online	C/N: 0.0dB	RX Datarate: 0 kbps	EL: 41.7°
OK2UUJ - Olomouc, Czechia	Online	C/N: 0.0dB	RX Datarate: 0 kbps	EL: 15.8°
GHY-122-H - Goonhilly Earth Station, Cornwall, UK	Online	C/N: 21.6dB	RX Datarate: 902 kbps	EL: 26.0°
GHY-122-S - Goonhilly Earth Station, Cornwall, UK	Online	C/N: 0.0dB	RX Datarate: 872 kbps	EL: 26.0°
VSE-NL-01 - Von Storch Engineering, Delft, Netherlands	Online	C/N: 0.0dB	RX Datarate: 857 kbps	EL: 31.3°

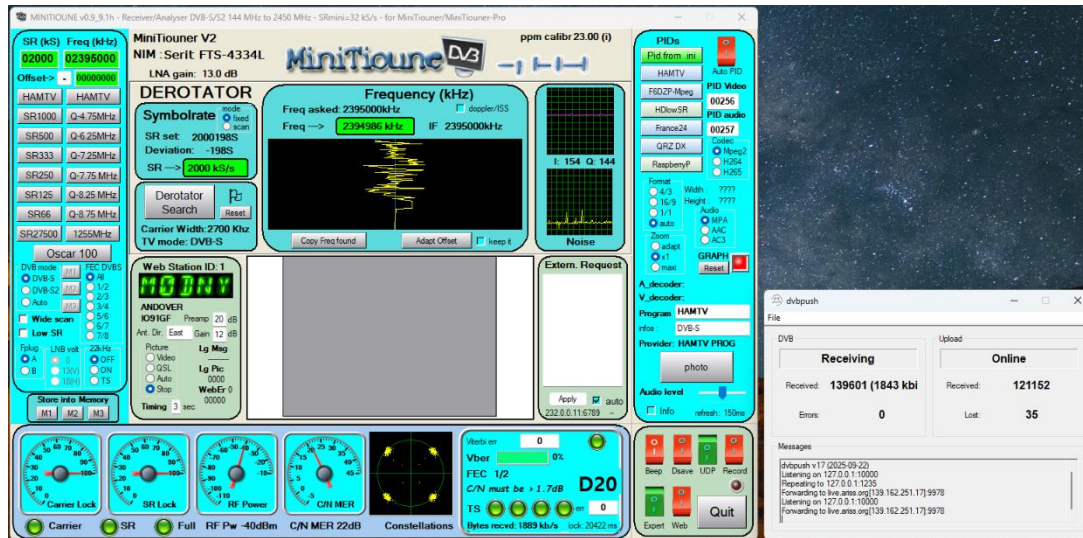
- G8GKQ
 - Salisbury, UK
- IK1SLD
 - Casale Monferrato, Italy
- OK2UUJ
 - Olomouc, Czechia
- Goonhilly Earth Station
 - Cornwall, UK
- Von Storch Engineering
 - Delft, NL

SatDump Issues – Errored DVB Frames

- More discontinuities in merged TS stream than expected.
 - Caused stalling of players.
- MPEG-TS PCR values in the merged stream are not regular.
 - During a pass the clock should be predictable.
- Irregular PCR values only seen from SatDump SDR receivers.
- SatDump does not filter frames where Reed-Solomon reports uncorrected errors.
 - Modified version is in local testing.



HAMTV Operational Use – Volunteers?



- Suitable Receiver
 - Minitioune + dvbpush
 - Portsdown (/Longmynd)
 - SatDump + dvbpush
- Reliable internet
 - 5Mbps upload required
- Onboarding process
 - Internet connection assessment
 - Upload error-rate tests

Questions?

- ARISS School Contacts Live Streams: <https://live.ariss.org/>
- HAMTV TS Merger Output: <https://live.ariss.org/hamtv/>
- Documentation: https://wiki.batc.org.uk/HAMTV_from_the_ISS
 - Linked pages on Ground Station construction, Contributing to the Merger.
- Join us on the ARISS Discord: <https://discord.gg/EBScTaKN>
 - Dedicated #hamtv channels

