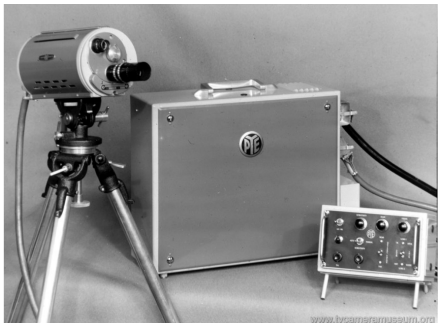
Digital ATV – Opening New Horizons

David Crump G8GKQ

Dave, G8GKQ

- Active with ATV since 1975
- Not an electronics professional
- Now retired for 7 years
- BATC and Portsdown Project
- QO-100 wideband bandplan lead

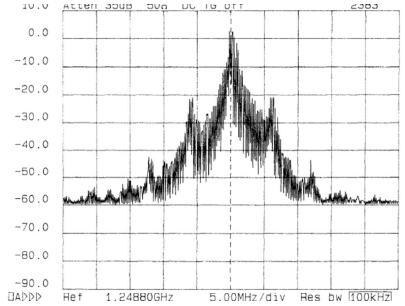


Why New Horizons?

- Brief Review of “old” ATV
- Intro to Digital ATV
- Benefits of Digital ATV
- Satellite ATV
- High Definition
- Equipment Options

“Old” Amateur TV

- AM on 70cm
- FM on 23cm and 3cm
- Followed broadcast standards
- Wide bandwidth



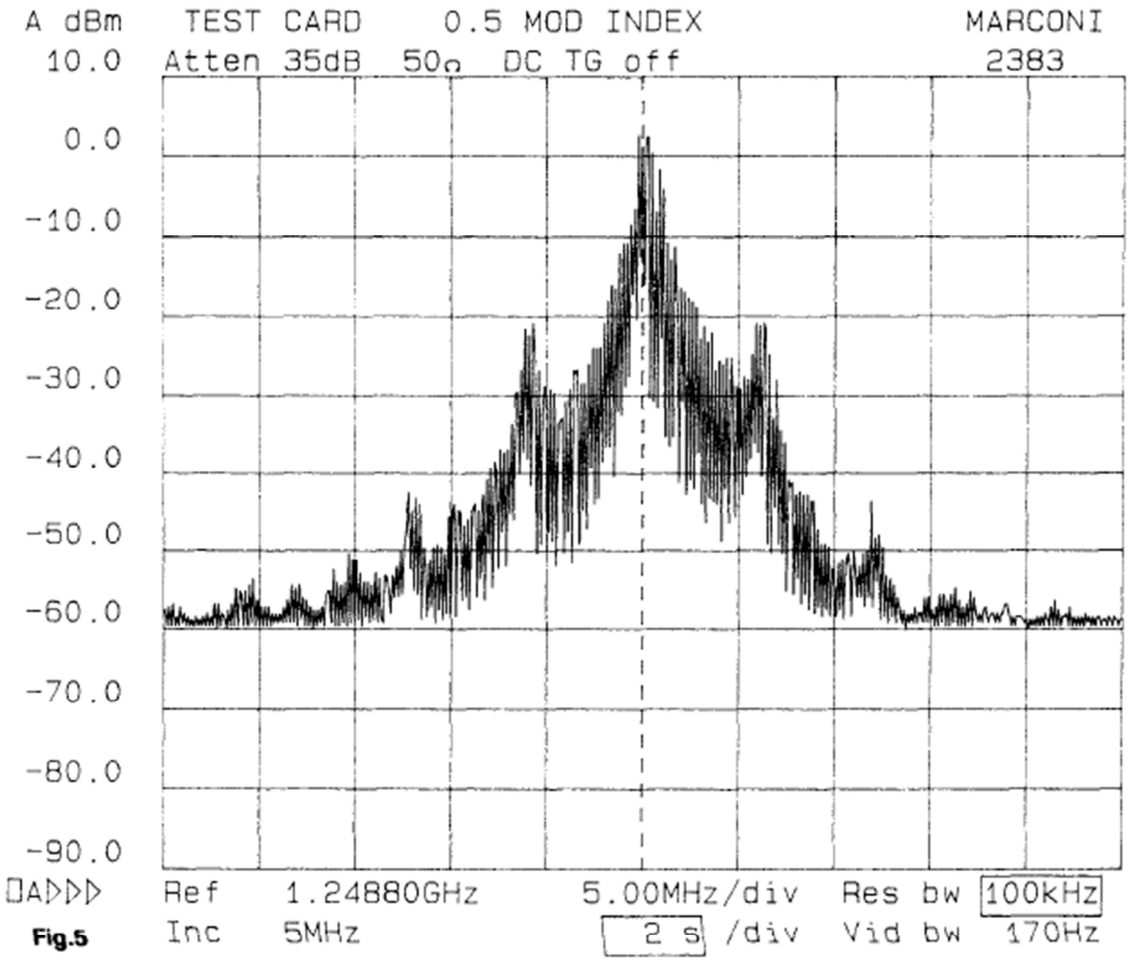
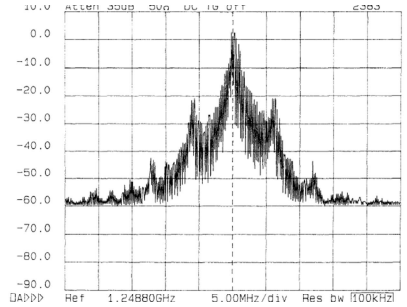


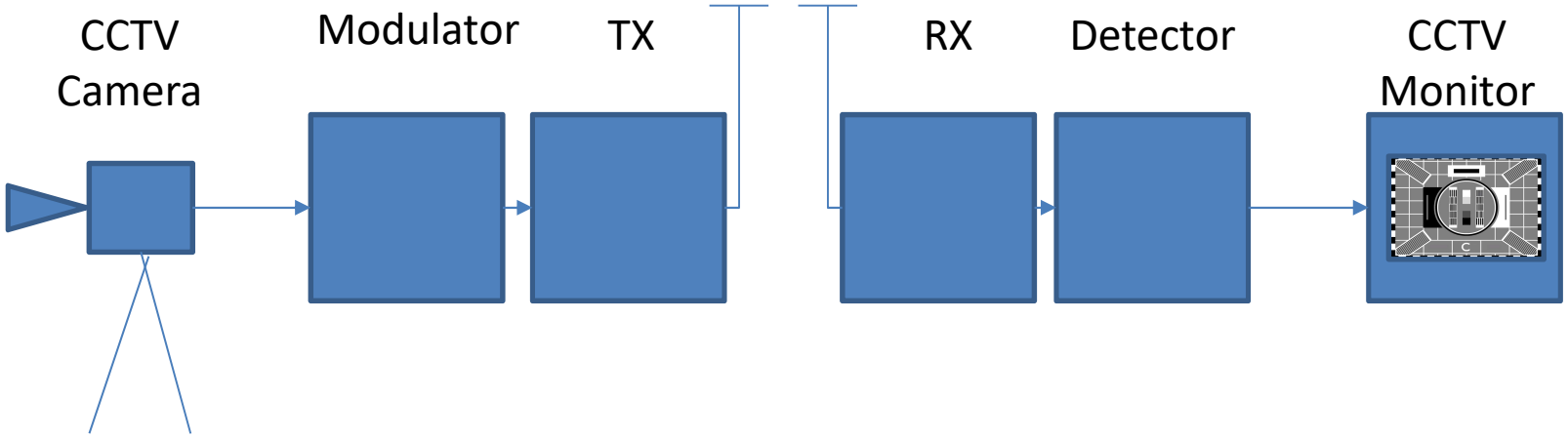
Fig.5

“Old” Amateur TV

- AM on 70cm
- FM on 23cm and 3cm
- Followed broadcast standards
- Wide bandwidth
- “Noisy” pictures



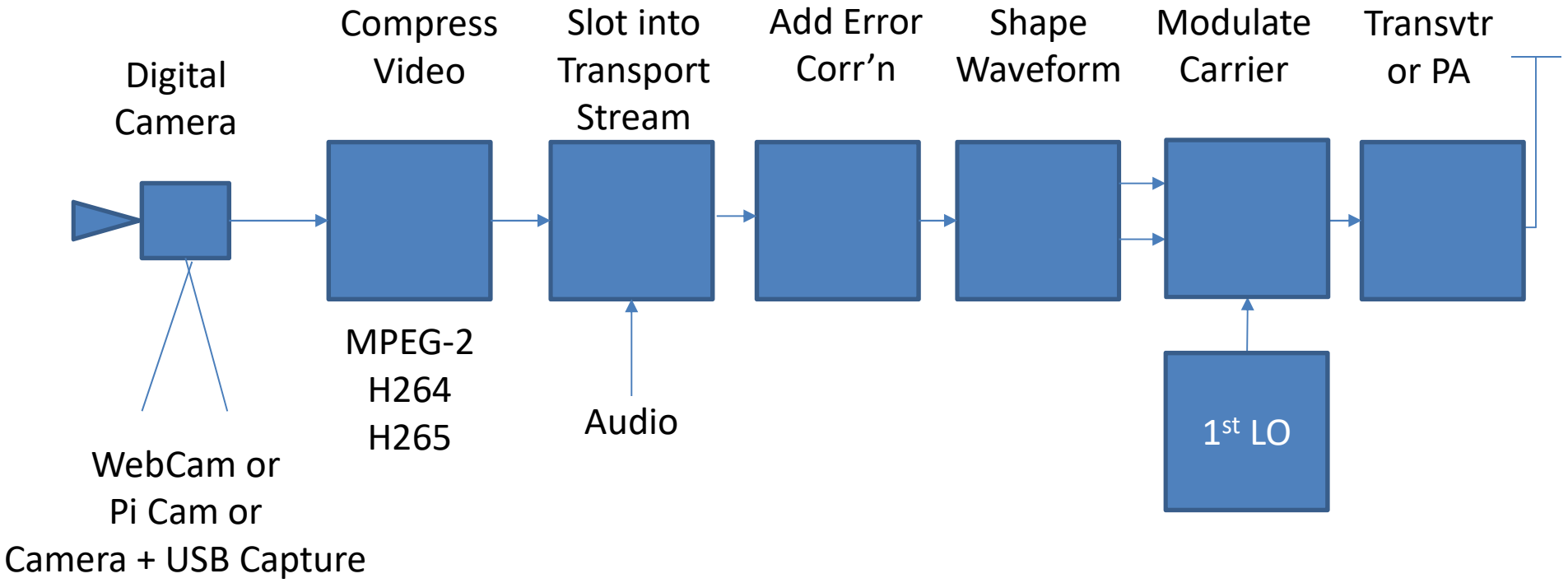
Analog ATV Block Diagram



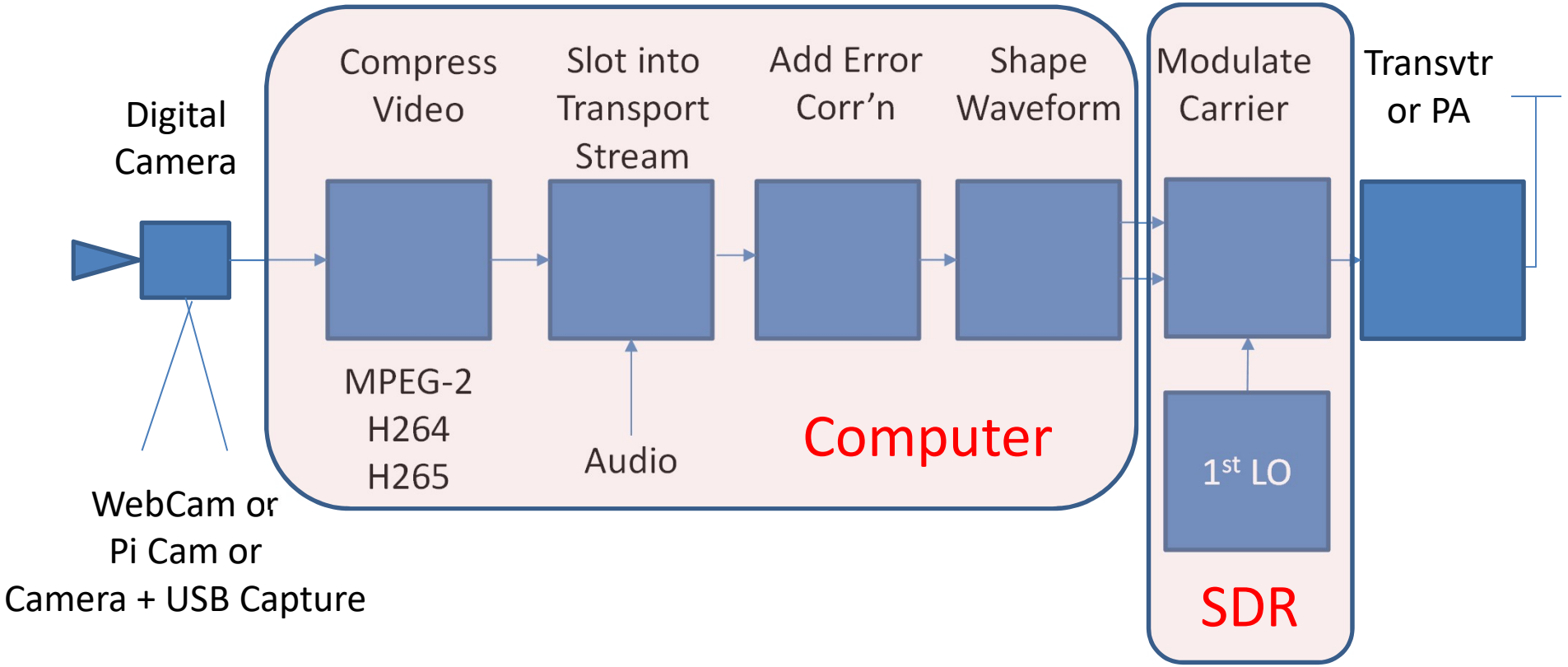
Digital TV

- Adopted by Broadcasters in 1990s
- Relies on lossy compression
- Configurable error correction
- Can fit multiple bits/sec into 1 Hz
- DVB-S and DVB-T variants

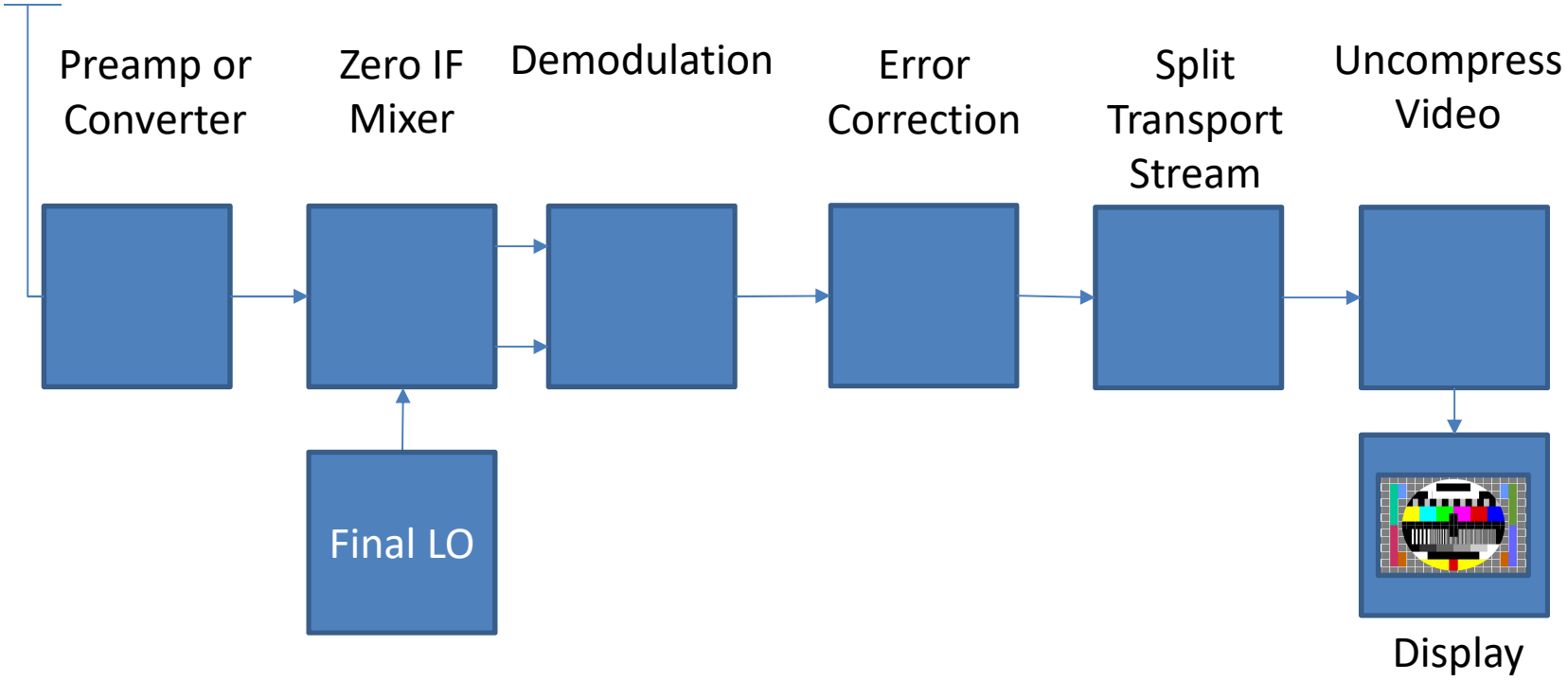
Digital TV Transmitter Block Diagram



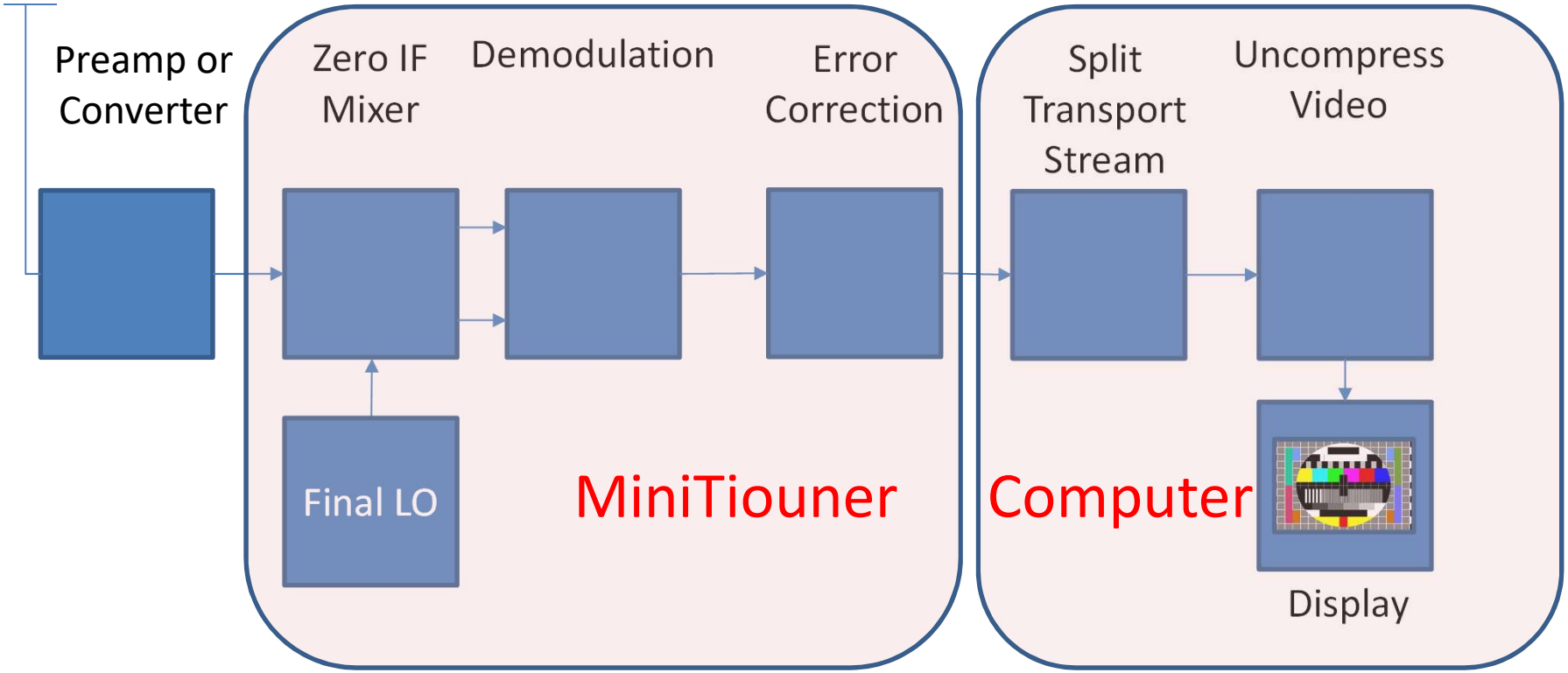
Digital TV Transmitter Block Diagram



Digital TV Receiver Block Diagram



Digital TV Receiver Block Diagram

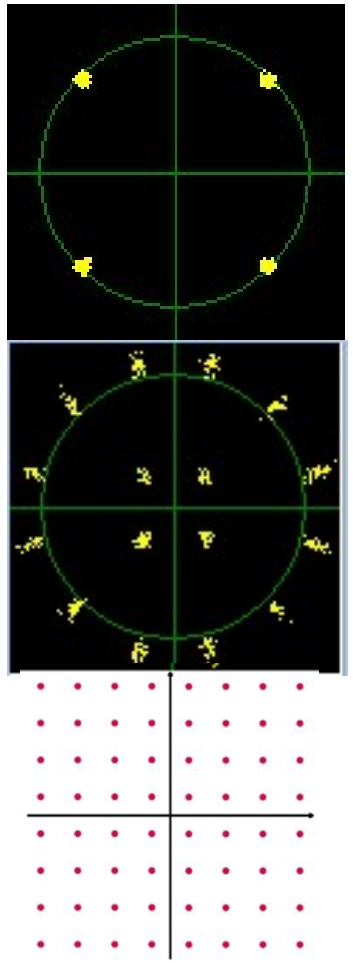


Digital TV Compression

- Encoders used to be 12U 19” rack
- Encoding: MPEG-2, H264, H265, AC-1
- Raspberry Pi includes an H264 encoder
- Jetson Nano includes an H265 encoder
- Modern PCs include H264 and H265

Digital TV RF Links

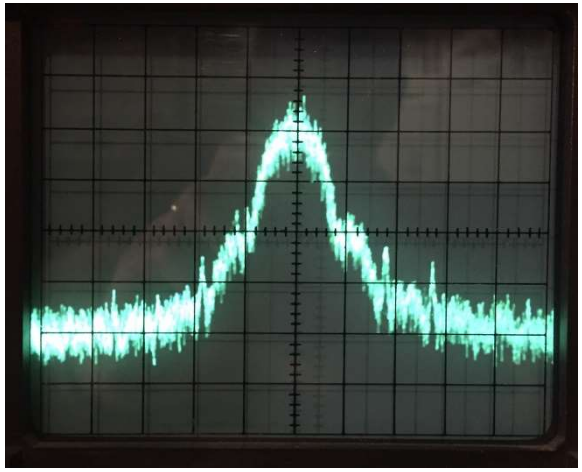
- DVB-S and DVB-S2 use:
  – QPSK, 8PSK, 16APSK or 32APSK
- DVB-T uses:
  – OFDM with 1,705 or 6,817 carriers
  – QPSK, 16QAM or 64QAM on each



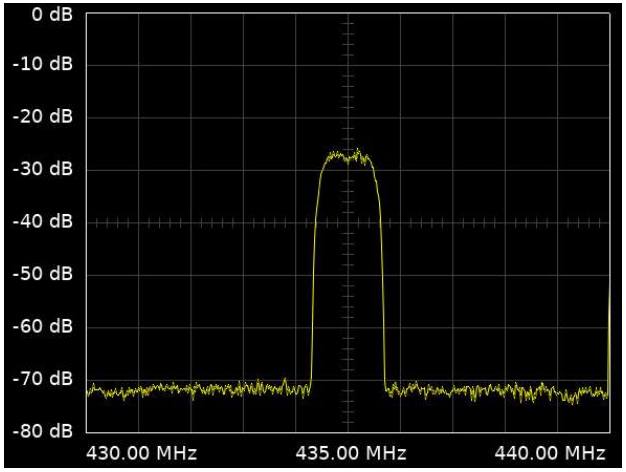
Amateur Digital TV

- Commercial DVB-S2 is 30+ MHz wide
- Commercial DVB-T is 8 MHz wide
- Initial DVB-S tests at 4, 2 and 1MS
- Extrapolated standard below 1MS
- Same for DVB-T – custom bandwidth
- Reduced Bandwidth TV (RB-TV)

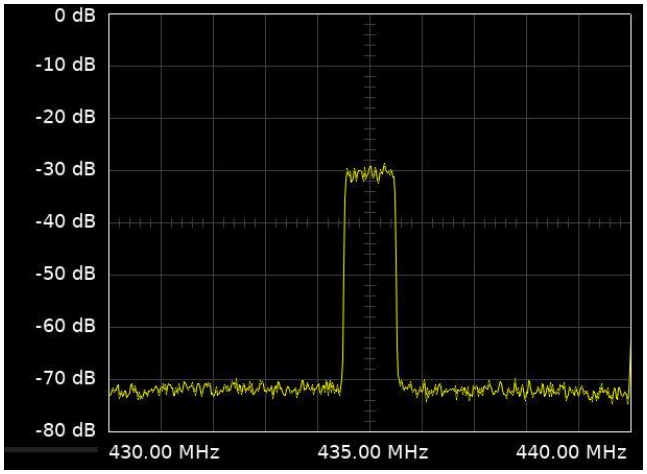
Digital TV Bandwidths



Pre-SDR DVB-S
2Ms @ 2MHz/div
3.5MHz @ 20dB
8MHz @ 40dB



SDR DVB-S2
1Ms @ 1MHz/div
1.4MHz @ 20dB
1.4MHz @ 40dB

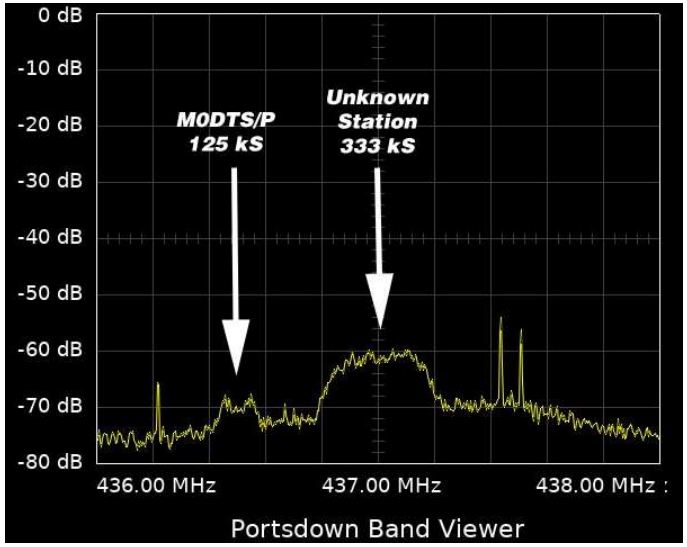


SDR DVB-T
1MHz BW @ 1MHz/div
1.0MHz @ 20dB
1.0MHz @ 40dB

Digital TV Error Correction

- DVB uses Forward Error Correction
- Uses proportion of bitstream for FEC
- Signal Content expressed as a fraction
- For example1/2, 2/3, 7/8 or 9/10
- Compromise between data and FEC
- Easy to encode, hard to decode

Benefits of DATV



- Symbol rate, error correction and modulation can be tailored
- For DX, use low SR and lots of error correction
- For local use higher SR
- Rarely needs more than 1.5 MHz bandwidth

Terrestrial DATV

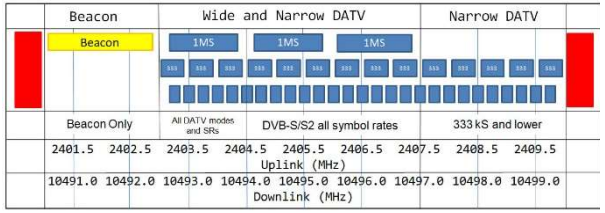
- New repeater standard 1MS FEC 2/3
- Simplex 333kS FEC 2/3
- DX 125kS FEC 2/3 or 1/2
- Use H264 or H265 encoding
- 50 MHz DX 1700km using 125kS
- 122 GHz “DX” 5.9km using 125kS

DVB-T vs DVB-S

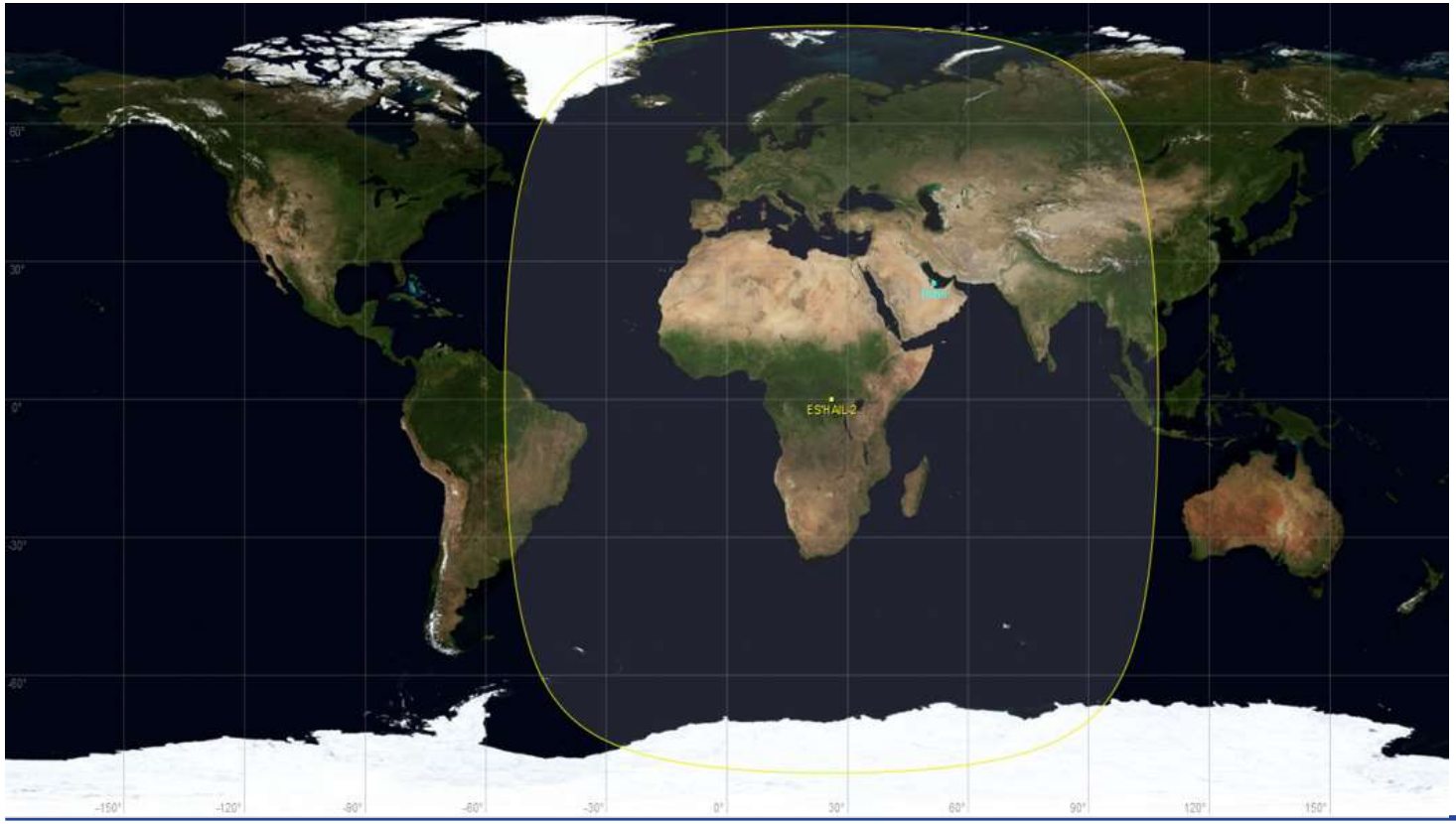
- DVB-S/S2 easier to generate than DVB-T/T2
- DVB-S/S2 easier to amplify
- DVB-S/S2 locks quicker
- Reduced bandwidth DVB-S/S2 less susceptible to multipath
- Trials suggest DVB-S/S2 is best

QO-100 Wideband

- Es'hail-2 carries 2 transponders
- QO-100 narrowband (500kHz)
- QO-100 wideband (9MHz)
- 2.4GHz up, 10.49GHz down
- Wideband has tighter link budget
- Demo downstairs



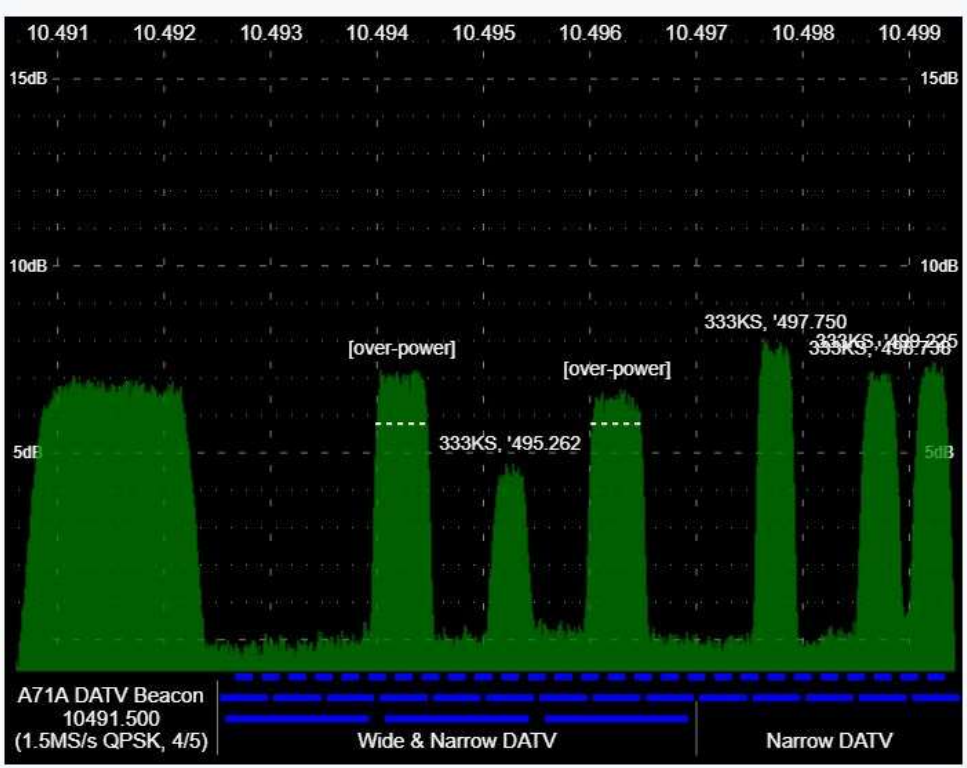
QO-100 Coverage



QO-100 Utilisation

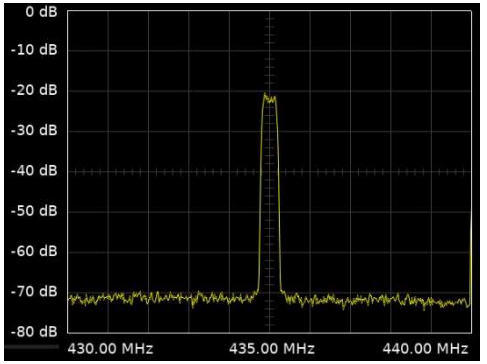
- Users from Brazil to India
- South Africa to Russia
- Over 250 known users
- In 7MHz available bandwidth

QO-100 Coordination

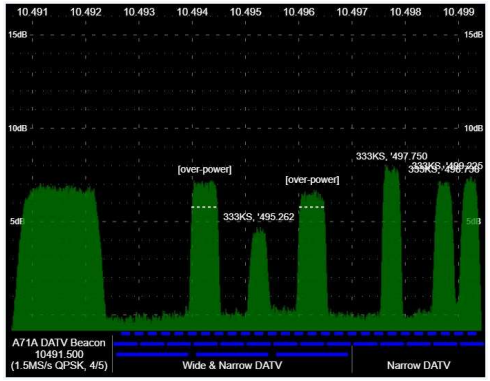


QO-100 Net Example

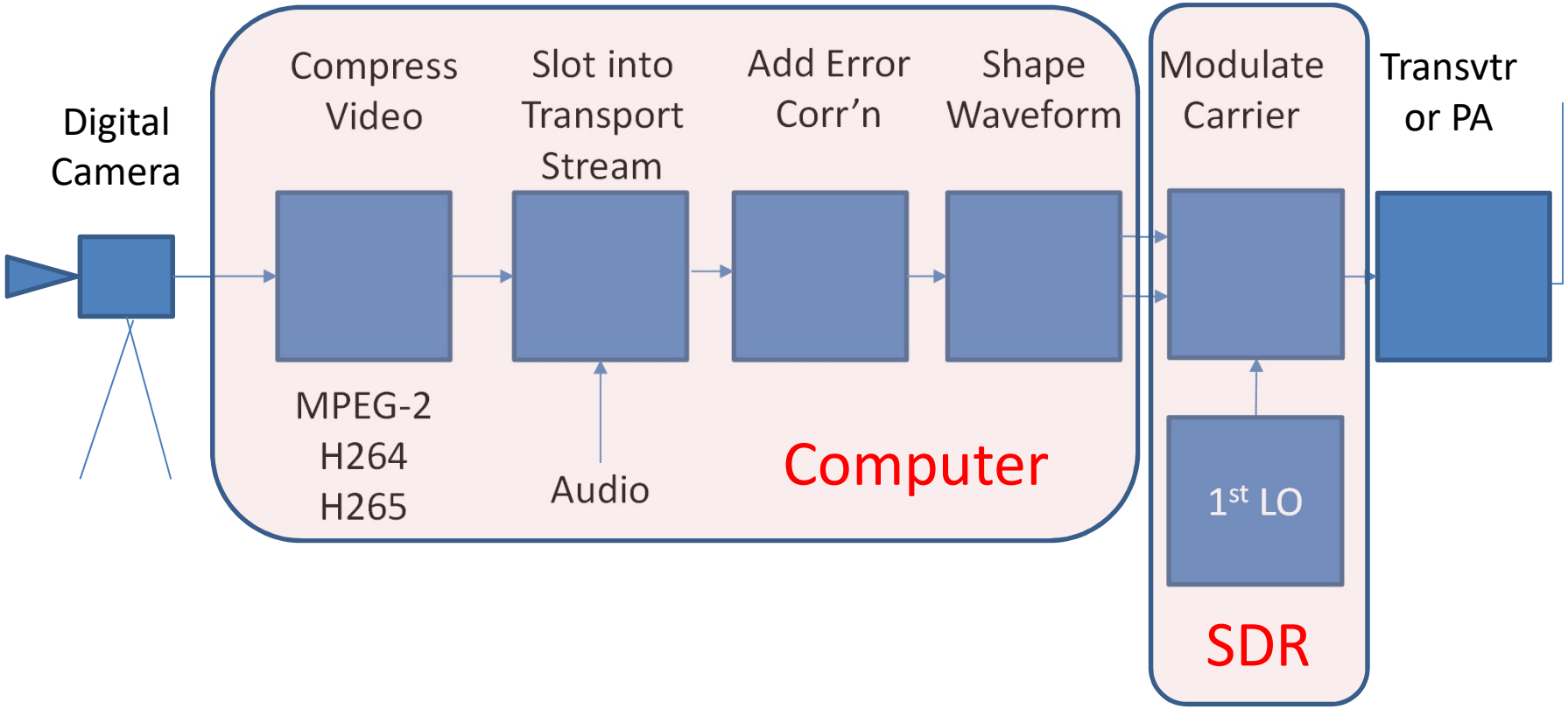
High Definition



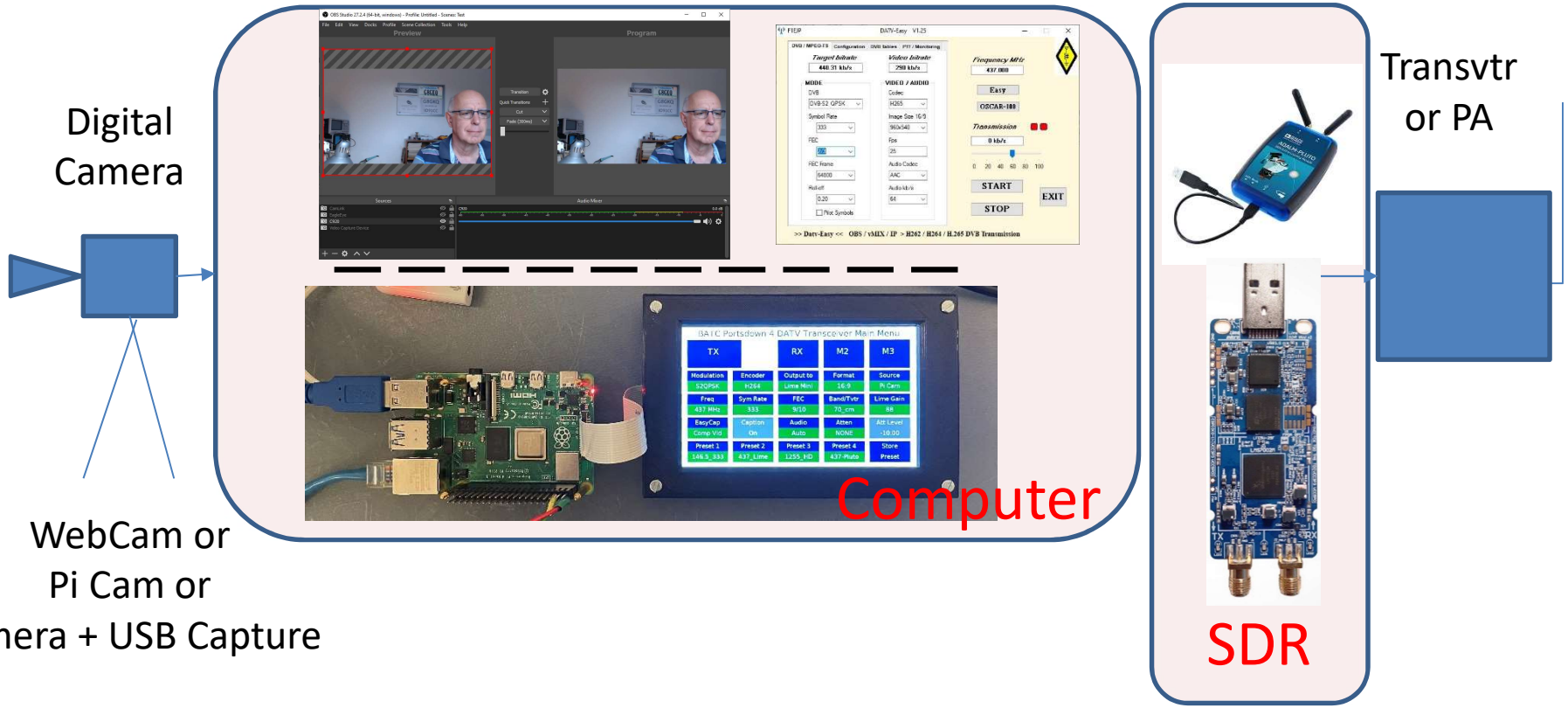
1920x1280
in 500kHz



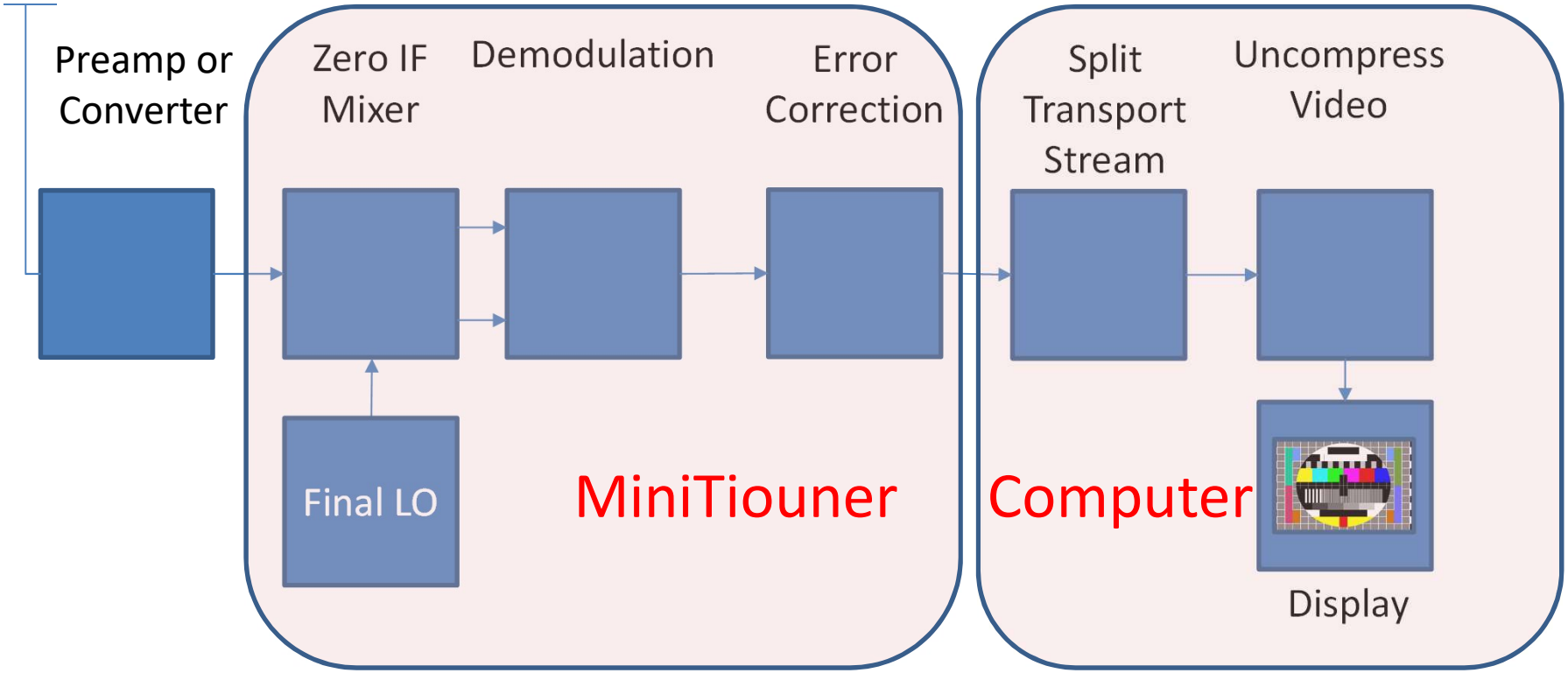
Transmission Techniques



Transmission Techniques

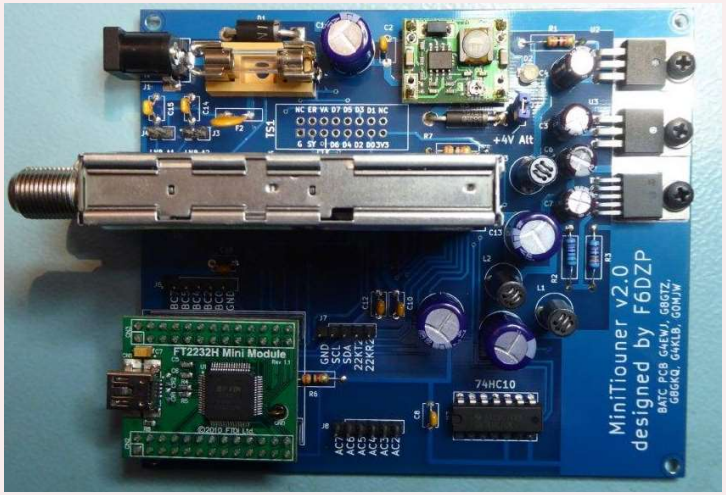


Receive Techniques



Receive Techniques

Preamp or Converter



MiniTiouner

Computer

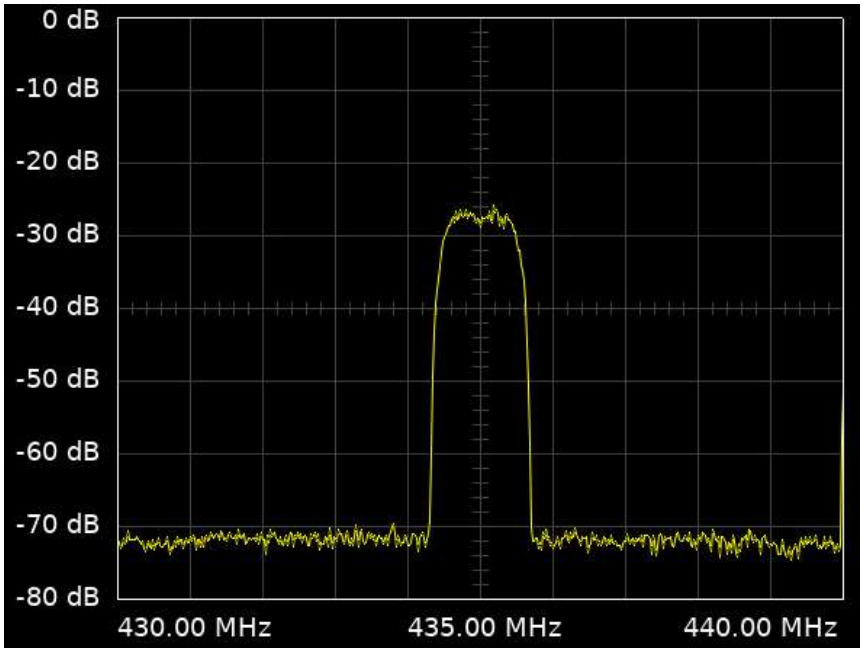
Equipment Options

- MiniTiouner receives 144-2350 MHz
  – But needs prior gain
- SDRs cover 70-3500 MHz
  – But only produce about 1mW
- So we need Preamps, PAs and Transverters

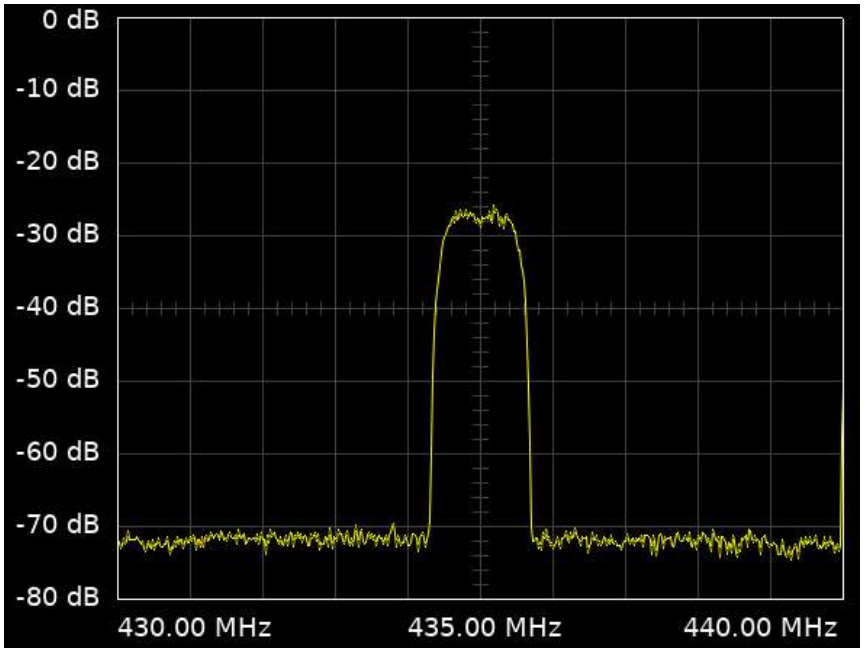
Terrestrial Equipment Options

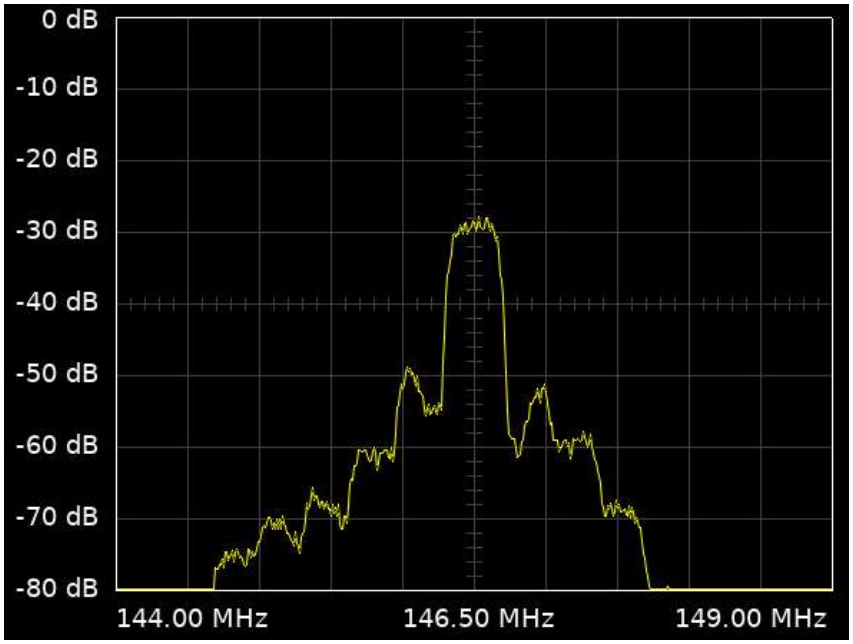
- Receive: as for SSB/FM/CW
  – But aim for 30dB of gain
- Transmit: needs to be very linear
  – Normal SSB PAs not good enough
- Use normal microwave transverters
  – But watch TX linearity

Amplification Linearity



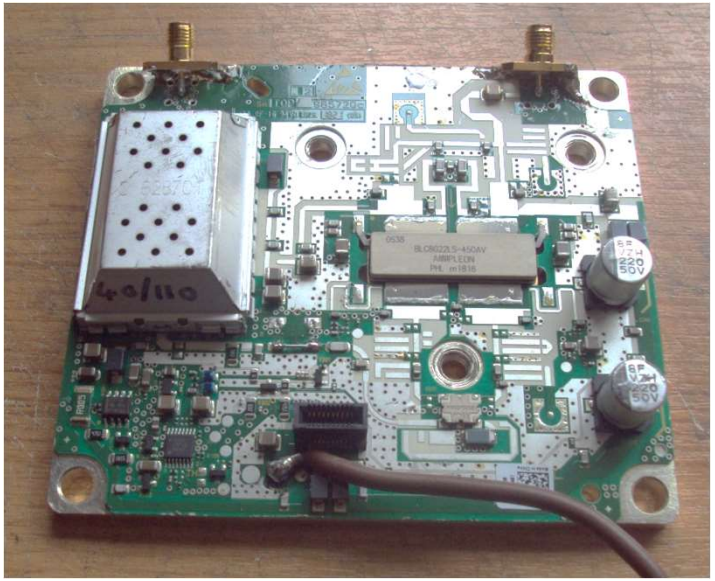
Amplification Linearity



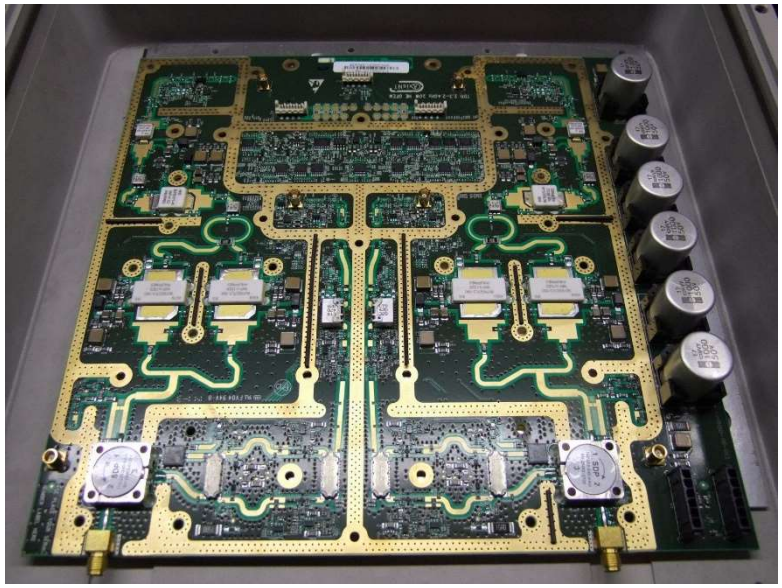


QO-100 Equipment

QO-100 Power Amplifiers



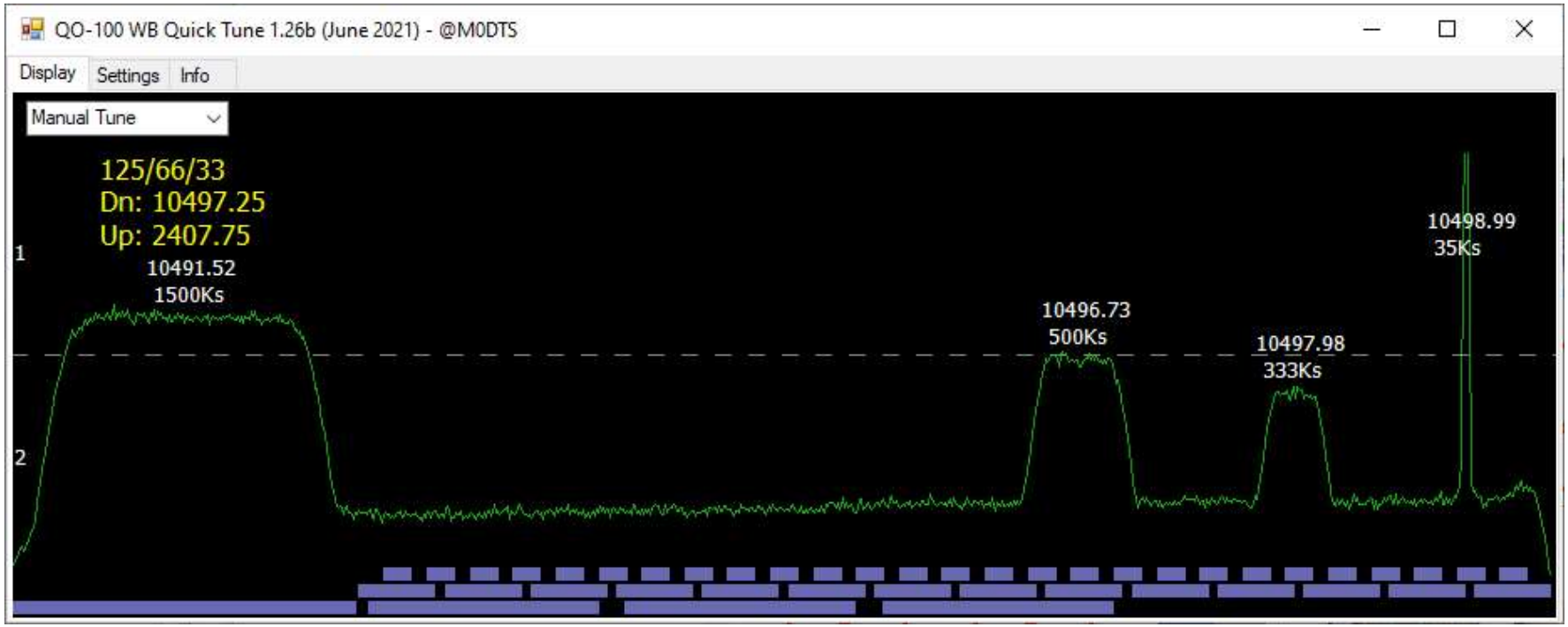
Nokia



AxisNT

Innovation: QuickTune

- Click on Spectrum – Tune RX



Innovation: Ryde Receiver

- Set-top box style DATV Receiver
- Uses IR Remote Control
- On-screen Menus
- RF in, HDMI out
- Open source software

Why New Horizons?

- Reach – DATV goes further
- QO-100 – Intercontinental DATV
- Equipment – Computer and SDR
- Innovation – through collaboration

Questions

theRSGB @theRSGB YouTube RSGB 2022 Convention

Find out more…

https://wiki.batc.org.uk/

dave.g8gkq@gmail.com

BATCOnline

@BATCOnline

www.rsgb.org

RSGB 2022 Convention