QO-100
Presentation
FRARS Hamfest
11/Aug/2019
All you need to know to get going on Qatar Oscar 100 geo-satellite

Presented By:
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What is QO100

- Qatar / Oscar 100 - Es’hail-2 is a geostationary satellite much like Astra used for Sky satellite TV
- Amateur payload built by Mitsubishi Electric CO with input from QARS + Amsat-DL
- Narrow transponder is 250KHz wide (800KHz)
- Wideband transponder is 8MHz wide
- Basically a bent-pipe repeater that covers 1/3 of Earth, up on 2.4GHz, down on 10GHz
Where is QO100

- Es’hail-2 is located at 25.9 east only a couple of degrees away from where a standard Sky-TV dish points, 38945Km away from us in the UK.
What is the coverage
What is the transponder
How do you RX it

- Use the Goonhilly Down Web SDR narrow band

https://eshail.batc.org.uk/nb/
How do you RX it

- Use the Goonhilly Down Web SDR wide band
What equipment do you need to RX it

- Use your own RX, dish and LNB;
What equipment do you need to RX it

- Standard 80cm dish will give excellent RX!
What equipment do you need to RX it

• A modern LNB (without frontend filter)

(Use a ‘PLL’ LNB which is more stable than the typical DRO TV LNB)
What equipment do you need to RX it

• LNB stability:
  • Use a PLL LNB instead of a DRO LNB
  • Lock the reference crystal (25/27 MHz) to 10 MHz frequency reference (GPS, Rubidium or TCXO)
  • Not needed for DATV
  • You can use software frequency correction if you are brave!
What equipment do you need to RX it

- a DC power inserter

- 10-14V = vertical polarisation (narrow band)
- 15V+ = horizontal polarisation (wide band)
- 22KHz = Low/High band (LO 9750 / 10600mhz)
What equipment do you need to RX it

- A Receiver:
  - RTL-SDR, RSP, Airspy, HackRF, any SDR covering 600MHz-1.5GHz + suitable software
  - 2M / 70cm transceiver
  - Additional IF down converter (739MHz > 2M / 70cm)
  - A ready out of the box solution DB6NT (not recommended)
What equipment do you need to RX it

• Receive IF frequency calculation:
  
  • NB transponder CW beacon 10489.550 MHz
    Vertical polarisation
  
  • 10489.550 MHz - standard LNB LO 9750 MHz = 739.550 MHz IF (25MHz xtal)
  
  • 10489.550 MHz - LNB LO 9360 MHz = 1129.550 MHz IF (24MHz xtal)
  
  • 10V-14V LNB power for vertical polarisation, 22 KHz off
Remember;

• If using a ‘web SDR’ then your QSO will not be valid!
• For a valid QSO you will need to have QO100 TX/RX at your location
How do you TX into it

• A multimode driver rig 2M / 70cm (or SDR exciter)
• A transverter to produce 2.4GHz output.
• A suitable 2.4GHz power amplifier to give a few watts at the feed
• 60cm+ dish with LHCP feed
• Use 2400.050MHz to 2400.300MHz segment
How do you TX into it
How do you TX into it

<table>
<thead>
<tr>
<th>Uplink (EOC, SFD = -106 dBW/m²)</th>
<th>Downlink (EOC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freq</strong></td>
<td><strong>Freq</strong></td>
</tr>
<tr>
<td>2.4 GHz</td>
<td>10.5 GHz</td>
</tr>
<tr>
<td><strong>Dish size</strong></td>
<td><strong>TWTA output power</strong></td>
</tr>
<tr>
<td>0.75 m</td>
<td>100 W</td>
</tr>
<tr>
<td><strong>Antgain</strong></td>
<td><strong>OBO</strong></td>
</tr>
<tr>
<td>23.64 dBi</td>
<td>6 dB</td>
</tr>
<tr>
<td><strong>HPA Output Power</strong></td>
<td><strong>On-board losses</strong></td>
</tr>
<tr>
<td>10 W</td>
<td>1.5 dB</td>
</tr>
<tr>
<td><strong>Uplink path losses</strong></td>
<td><strong>S/C Ant. Gain</strong></td>
</tr>
<tr>
<td>1.5 dB</td>
<td>17 dBi</td>
</tr>
<tr>
<td><strong>Ground EIRP</strong></td>
<td><strong>S/CEIRP</strong></td>
</tr>
<tr>
<td>32.14 dBW</td>
<td>29.5 dBW</td>
</tr>
<tr>
<td><strong>Earth-S/C distance</strong></td>
<td><strong>Power sharing</strong></td>
</tr>
<tr>
<td>41126 Km</td>
<td>50 channels</td>
</tr>
<tr>
<td><strong>Free Space Loss</strong></td>
<td><strong>S/CEIRP per channel</strong></td>
</tr>
<tr>
<td>192.3 dB</td>
<td>12.5 dBW</td>
</tr>
<tr>
<td><strong>95% availability att</strong></td>
<td></td>
</tr>
<tr>
<td>0.12 dB</td>
<td></td>
</tr>
<tr>
<td><strong>S/C G/T</strong></td>
<td><strong>Ground Sta. G/T</strong></td>
</tr>
<tr>
<td>-12 dB/K</td>
<td>13.98 dB/K</td>
</tr>
<tr>
<td><strong>C/N0</strong></td>
<td><strong>C/N0</strong></td>
</tr>
<tr>
<td>56.3 dBHz</td>
<td>49.4 dBHz</td>
</tr>
<tr>
<td><strong>Channel Bw</strong></td>
<td><strong>Channel Bw</strong></td>
</tr>
<tr>
<td>2.5 KHz</td>
<td>2.5 KHz</td>
</tr>
<tr>
<td><strong>C/N per user (PEP)</strong></td>
<td><strong>C/N per user (Avg.)</strong></td>
</tr>
<tr>
<td>22.3 dB</td>
<td>15.4 dB</td>
</tr>
</tbody>
</table>
How do you TX into it - Frequencies / Band Plan
How do you TX into it

- A 2M or 70cm multi-mode rig
How do you TX into it

- A 2400 MHz up-converter or transverter
How do you TX into it

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How do you TX into it

• A dish feed for 2400 MHz LHCP (single or separate RX/TX antenna)
How do you TX into it

- A feed for 2400 MHz LHCP (single or separate RX/TX antenna)
How do you TX into it

• A feed for 2400 MHz LHCP
  (single or separate RX/TX antenna)
How do you TX into it

• A feed for 2400 MHz RHCP
  (single or separate RX/TX antenna)
How do you TX into it

- Dish feed needs to be LHCP for best results
How do you TX into it

- Few watts power amplifier to >60cm dish
How do you TX into it

- Few watts power amplifier to >60cm dish
How do you TX into it

- Calibrate your TX so it reads the 10489.xxx MHz downlink, i.e. 489.xxx MHz
- Net onto others far more easily!
- “BE” on frequency
- Do not under any circumstances tune during TX!
QO-100 - Gallery of shame

NO!
QO-100 - Gallery of shame

NO!
QO-100 - Gallery of shame

NO!
QO-100 - Gallery of shame

NO!

DM3AWK
QO-100 - Gallery of shame

NO!
How do you TX into it

• Ensure **you can monitor** your own 2.4GHz uplink signal
• Cheap SDR’s cover 2.4GHz, old Cal-Amp MVDS down converters cover the same band
• Don’t use the transponder receiver as part of your test equipment!
• Set your signal peak to that of the CW beacon
• Ensure your signals are clean and of good quality before transmitting into your antenna!
Ground station enhancements

- Lock LNB to a GPSDO for frequency precision
- Lock your transverter to GPS as well
- Fit a TCXO in your driver rig or lock to GPS
- Add a power amplifier for DATV modes or use a bigger antenna
- Make a digital modes interface
DATV:

A screenshot of a test pattern screen showing the text "MOEYT OP: Paul" in the center. The screen also displays various technical details and settings related to the DATV receiver and signal analysis tools.
DATV: Receivers

- RX: MiniTiouner F6DZP direct receiving
DATV: Software

- RX: MiniTiouner F6DZP direct receiving
DATV: Down Converter

- RX: DVBS/S2 RX (low symbol rate capable)
- Additional up-converter & LO
M0EYT QO100 setup:

RX:

- Golden Interstar GI202 LNB GPS locked 24MHz
- Single 1.2M offset dish + dual band feed
- Leo Bodnar GPSDO-mini (24MHz o/p)
- AR5000 (locked to 10MHz) for SSB / etc
- AirSpy on 1129.675MHz +- for pan-adapter
- BATC MiniTiouner for DATV
M0EYT QO100 setup:

TX:

- Elad FDM-DUO (GPS 10MHz)
- G4DDK 10M to 70cm transverter (GPS 101MHz)
- SG-Labs 70cm to 13cm transverter (GPS 10MHz)
- Leo Bodnar GPSDO-mini (101MHz)
- PE1RKI 100W power amplifier (@3W o/p)
- Single 1.2M offset dish + dual band feed
M0EYT QO100 setup:
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M0EYT QO100 setup:
M0EYT QO100 setup:
That’s all there is to it! See you on the satellite!

73’s DE M0EYT
Credits:

Original Presentation : M0EYT
Updated by : ON4BCB
Tweaks for FRARS : M0EYT