ALL THE LATEST NEW GEAR

What's new from all the UK's leading retailers

RadioUser

February 2021 £4.99 www.radioenthusiast

REVIEW SPECIAL | **A look at the top guides for 2021**

AMATEUR RADIO

Our how-to guide to start transmitting

Beating the bug

How broadcasting has worked around Covid-19

Numbers game

The science of compiling radio audience statistics

HISTORY **The father of FM broadcasting**

How Edwin Howard Armstrong changed the face of modern radio

SPACE **Radio astronomy for the beginner explained**

A history, interesting projects that you can try at home, plus a profile of the UKRAA

Pure Elan Connect DAB/Bluetooth Radio | Space-based ADS-B | The Transistor
European Broadcasting Union | Food Programmes | Hyperbolic Radio Navigation

02
9 771748 811135
WARNERS
Display until 25th February 2021

WE ARE OPEN FOR INTERNET AND TELEPHONE ORDERS!

NEW

Icom IC-R8600
Wideband Communications Receiver

- Coverage: 0.01-3000MHz
- Decodes D-STAR, NXDN, dPMR and APCO P25
- Large 4.3 inch TFT colour touch screen display

GENEROUS PART EXCHANGE AVAILABLE

£2499.99

Tecsun S-2000
LW/MW/FM-Stereo/SW (with SSB) and Airband

- 1000 station memories
- Signal Attenuator
- Dual timer alarm
- Wide/narrow filters
- 1000 station memories
- Dual alarm clock function
- MP3: Aux input
- Rotary Antenna: MW/LW

£299.95

Tecsun S8800 GM
SSB Shortwave Radio

- FM, SW, MW, LW • SSB with LSB/USB
- 650 station memories
- Deluxe Gun Metal Tuning knob
- Remote control, Alarm & sleep/timer
- DX/Local antenna gain control
- Built-in battery charging feature
- Supplied with batteries & remote control

£279.95

POWEREX

NEW

Powerex C-9000-Pro
Battery Charger Analyser

Advanced unit suitable for all your batteries

- **Charge from:** 1 to 4 AA or AAA niMH/NicD
- **4 modes:** Charge, Discharge, Refresh, Analyse
- **Displays:** Capacity, Voltage, time & rate

£69.95

BEARCAT

UBC-75XLT
Popular 'Airshow' scanner

- 25-512MHz (with gaps)
- Modes: AM/FM
- 300 channels
- Close Call

£99.95

EZI-33XLT
Compact handheld - easy to use!

- Covers: 78 MHz-512MHz (w/gaps)
- PMR, Marine, Aircraft, FM, etc.

£64.95

UBC-370CLT
500 channel AM/FM scanner

- Includes VHF FM broadcast radio
- Covers: 25 - 960MHz (w/gaps)
- Listen to PMR, Marine, Air, CB, Amateur

£119.95

HEADPHONES

Yaesu STA77
Lightweight Stereo headphones - as used by our boss!

£79.95

JIM M75

Wide Band pre-amp
Low noise pre-amp with 3 band pass filters

- 24-2150MHz
- Variable gain
- 12V DC or PP3 battery (not supplied)

£89.95

ANTENNAS

Create Log Periodic Antennas - Japan
as used by the 'Professionals'

CLP-5130-1N
21 Element LPA

- 50-1300MHz
- Gain: 10-12dBi

£379.95

CLP-5130-2N
17 Element LPA

- 105-1300MHz
- Gain: 11dBi

£299.95

DIAMOND D-777 Airband Antenna

Fibreglass 1.7m long, this antenna gives High Gain coverage of VHF/UHF Airband

£64.95

Scanmaster HFA
Active Receive Antenna
Covers: 1.8-30MHz

8" long c/w all leads - just needs 12V DC!

£44.95

Sirio SD-3000N Discone
High quality stainless steel, chromed brass & anodised aluminium construction

- 300 MHz-3GHz

£69.95

Scanmaster Desktop
Indoor Discone antenna
25-1300MHz complete with cable and BNC plug

£49.95

Tecsun Receive Loops

AN200
MW passive loop **£39.95**

AN48X NEW!
Covers: SW, MW, LW
Active wire loop.....**£39.95**

AOR LA-400
Low Noise - hear weak signals in the LW, MW and SW Bands

- Receives 10kHz-500MHz
- 30.5cm diameter Loop
- 20dB built-in Pre-amp

£399.95

End Fed Wire Receive Antenna

High quality complete kit includes mounting hardware & coax cable

- Covers: 2-30MHz
- Kevlar Mil spec. wire
- Length: 20m

£69.95

AIRSPY

NEW

Airspy HF+ Discovery

- Pre-selectors
- 9kHz - 13MHz
- 60MHz - 260MHz
- Use over internet
- 60 x 45 x 10 mm

£199.95

AIRSPY R2
VHF/UHF/SHF Receiver

- 24MHz-1,800MHz
- 10MHz panoramic spectrum
- 3.5 dB NF (42-1002)MHz
- Tracking RF filters

£209.95

AIRSPY Mini

- SDR Dongle
- 24 – 1,800MHz

£119.95

SIRIO Antennas

Quality Antennas from Italy!

WY108-3N
Airband
3 element Beam

- Freq: 108-137MHz
- Gain: 7 dBi
- Boom: 1.4m

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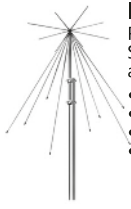
CX4-68	(68 – 73)MHz 4m 4.15 dBi	**£69.95**
CX440	(440 – 455)MHz pmr 4.15 dBi	**£39.95**
CX455	(455 – 470)MHz pmr 4.15 dBi	**£39.95**
TORNADO 50-60	(50 – 60)MHz 6m 3.5dBi	**£59.95**

HF/VHF/UHF Beams

SY3	3 el (26-28)MHz 10.65 dBi	**£99.95**
SY4	3 el (26-28)MHz 13.15 dBi	**£119.95**
SY50-3	3 el 50MHz 8.5 dBi	**£99.95**
SY50-5	5 el 50MHz 10.5dBi	**£129.95**
SY68-3	3 el 70MHz 7.0 dBi	**£79.95**
WY108-3n	3 el 108-137MHz 3 el. Air Band	**£89.95**
WY140-6n	6 el 144MHz (wide band) 10.5 dBi	**£99.95**
WY400-6n	6 el 432MHz (wide band) 11.0dBi	**£79.95**
WY400-10n	10 el 432MHz (wide band) 14.0dBi	**£119.00**

ICOM



Icom AH-8000
Professional Discone Antenna Suitable for both Transmit and Receive

- Rx: 100-3,300MHz
- Tx: 144, 430, 1200, 2400MHz
- Height: 936mm
- Supplied c/w 15m cable + N connector & Mounting hardware

£240

SPIDERBEAM MASTS

Fibreglass Telescopic Poles

12 metre Heavy Duty	£89.95
18 metre Standard	£199.95
22 metre 'Long John' NEW	£399.95
26 metre Standard	£499.95

Aluminium Telescopic masts

10 metre Standard	£299.95
10 metre Heavy Duty	£325.00
12.5 metre Standard	£329.95
14.5 metre Heavy Duty	£425.00
15 metre standard (2m retracted)	£399.95

SDRplay

NEW

RSPdx
SDR in metal case
Covers: 1kHz-2GHz

Now with Improved:

- Performance below 2MHz
- Plus more!

£194.95

RSP 1A
Wideband Budget SDR

- Covers: 1 kHz - 2GHz
- Software upgradable
- Good dynamic range

£99.95

RSP DUO Dual Tuner SDR

- Covers: 1 kHz - 2GHz
- Software upgradable

£239.95

NEVADA Power Supplies

Quality Power Supplies 2 YEAR WARRANTY!

PSW-30
Switch Mode

- 25-30A supply
- Low noise

2 YEAR WARRANTY

£79.95

PS-40M
Linear

- 40A (max) with meter
- 1.5-15V DC
- Cigar adaptor output

£129.95

PS-08	Linear 8A (max) 13.8V DC	**£34.95**
PS-30M	Linear 30A (max) 3-15V DC	**£99.95**
PSW-50	Switch mode 50A (max) 9-15V DC	**£129.95**
PSW-30	Switch mode 30A (max) 9-15V DC	**£79.95**
PSW-30H	Switch mode 30A (max) 9-15V DC	**£69.95**
PS23-SW1	Switch mode 23A (max) 13.8V DC	**£59.95**
PSW-07	Switch mode 7A (max) 13.8V DC	**£29.95**
PSW-04	Switch mode 5A (max) 13.8V DC	**£24.95**

ULTRA LOW LOSS COAX

Ecoflex 15
per metre.....£7.99 price per 102m drum **£759**

Ecoflex 15 plus
per metre.....£7.99 price per 102m drum **£759**
PL259 connector (Part: 7350).....**£8.95**
N type connector (Part: 7395).....**£9.95**

Ecoflex 10
per metre.....£3.79 price per 102m drum **£359**

Ecoflex 10 Plus
per metre.....£3.79 price per 102m drum **£359**
PL259 connector (part: 7378).....**£5.95**
N type connector (part: 7367 .....**£6.50**

Aircell 7
per metre.....£2.99 price per 102m drum **£269**
PL259 connector (part: 7390).....**£2.65**
N type connector (part: 7392) **£5.25**

Aircell 5
per metre.....£2.75 price per 102m drum **£259**

Other 100M Coax Drums
Westflex 103..Semi Air-spaced low loss **£179.95**
RG-213 (Cabnex).....Low loss good quality **£99.95**
RG-Mini 8.....Super XX.....**£69.95**
RG58/CU.....Mil spec **£39.95**

Twin Feeders
450 Ohm.....Twin feeder **£89.00**
300 Ohm.....Twin feeder **£76.50**

Nevada Antenna Wire
Coated flex weave Antenna wire.....**£59.95**

New TECSUN Radios

JUST ARRIVED!

Tecsun PL-990x
High Performance SSB Shortwave Radio

£259.95

Considered to be the Tecsun design team's masterpiece!
Uses modern DSP technology to improve performance

- Covers: LW, MW, FM, SW (1.711-29.999) MHz
- MP3 player via SD port
- Memories: 3150
- Synchronous detector
- Local, Medium, DX input selector
- Powered by 18650 Lithium battery
- Bluetooth connectivity
- Optional USB mains supply.....£9.95

£89.95

Tecsun PL-330
SSB Shortwave Radio

- FM stereo, LW/MW/FM/SW
- 650 memories
- DSP technology
- Multi-function display
- Lots more info on our web site
- USB - Rechargeable battery

AOR AR-5700D
Digital Communications Receiver

- 10 digital modes - TETRA, P25(Phase 1), DMR, Mototrbo, dPMR, NXDN, D-CR, D-STAR, Alinco, Yaesu.
- Covers 9kHz - 3,700MHz
- 900kHz wide IQ output

£4595

PRICE MATCH

Now with TETRA!

AOR AR-DV1
100kHz-1300MHz Wide band reception

New Firmware - gives TETRA decoding and more!
Decodes virtually ALL popular digital modes: DMR, D-STAR, Yaesu Fusion and lots more!

Supplied with: 4GB SD Card

£1199.95

AOR AR-8600 MkII
Communications Receiver

- Frequency: 530kHz-3000MHz no gaps
- Modes: WFM, NFM, SFM, WAM, AM, NAM, USB, LSB, CW
- Memories: 1000 (20 banks)

£649.95

Optional Mains Power supply £25.95

AOR

LATEST FIRMWARE

AR-DV10
Digital Handheld Scanning Receiver

- 100kHz-1300MHz analogue and digital modes
- TETRA, P25 (Phase 1+2), DMR, Mototrbo, dPMR

~~£999.95~~
£939.95

ICOM

NEW

R-30
Digital & Analogue Multi Mode Scanner

- With dual watch and dual band recording
- Listen to two signals (analogue + analogue or analogue + digital)
- Decode D-STAR, P25, NXDN and dPMR digital (conventional) modes

£569.95

ICOM

IC-R6E
Pocket sized Wideband Scanner

- Freq: 100kHz-1309.995MHz
- Modes: AM, FM, WFM
- 1300 memories
- High Speed Scan 100 channels/second
- 15 hours receive capability

Optional BC-194
Drop-in charger stand
.....£22.95

£199.95

ALINCO

DJ-X11E
All Mode 1200 Channel

- Frequency: 0.1-1300MHz
- AM/FM/WFM/SSB/CW
- 1200 memories
- Twin VFO feature
- IQ output for SDR use
- 1800mAh Li-ion inc

£349.95

BEARCAT

BCT-15X
Latest Base Mobile Scanner with 'Close Call'

- 25-1300MHz (with gaps)
- 9000 memories
- AM/FM/WFM
- Band scope
- CTCSS/DCS decoding
- Alpha-numeric tagging feature
- GPS enabled

Supplied with:
- Mains adaptor
- DC Car Power Plug
- Telescopic Antenna
- Mounting Bracket and Hardware

£249.95

BEARCAT

NEW

SDS-100E
Advanced Digital & Analogue Scanner

- Frequency: 25-1300MHz (w/gaps)
- Weather Resistant IPX4

Standard Version
(licence required to activate DMR, NXDN)
£599.95

Activated Version
(DMR, NXDN already activated)
£649.95

BEARCAT

NEW

Bearcat SDS-200E
Digital Scanning Receiver

- With DMR, NXDN, and ProVoice monitoring modes
- Covers: 25 - 512MHz, 806 - 960MHz, 1240 - 1300MHz
- Too many features to list here - visit our web site for more details!

£779.99

BEARCAT

UBCD-3600XLT
Digital Scanner with 'Close Call' and Analogue AM/FM

- Receives: 25-1300MHz
- SD card slot

£425

UBCD-3600XLT - NXDN
Same specs as above but with NXDN activated NXDN digital protocol is used by Kenwood & Icom

£479.95

WHISTLER

Whistler TRX-2
Digital Scanner

- Receives 25-1300 MHz (with gaps)
- Covers DMR, MotoTRBO - and more!
- Upgradable CPU, DSP, and library
- Store Scan lists
- EZ Scan PC software
- IF/discriminator output
- Record & save to Windows
- Clock & Calendar function
- Spectrum Sweeper

£479.95

WHISTLER

Whistler TRX-1
Digital Scanner

- Receives 25-1300 MHz (with gaps)
- Covers DMR, MotoTRBO - and more!
- Upgradable CPU, DSP, and library
- Store Scan lists
- EZ Scan PC software
- IF/discriminator output
- Record & save to Windows
- Clock & Calendar function
- Spectrum Sweeper

£419.95

BEARCAT

UBC-125XLT
500 Channel AM/FM scanner

Easy to use scanner - our most popular for Civil/Military Airband

- 25-960MHz (w/gaps)
- Includes civil/Military Airbands
- Close call RF capture
- Alpha tagging
- CTCSS & DCS squelch modes

£129.95

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50 YEARS nevada

Contents

Favourites | Reviews | Features | News | Profiles

RadioUser

ISSN 1748-8117

February 2021 Vol. 16 No 2
On sale: 28th January 2021
Next issue on sale: 25th February 2021

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We regret that replies to technical queries cannot be given over the telephone. Any technical queries by e-mail are very unlikely to receive immediate attention either. So, if you require help with problems relating to topics covered by RU, then please write to the Editorial Offices, we will do our best to help.

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Warners Group Publications plc
The Maltings, West Street
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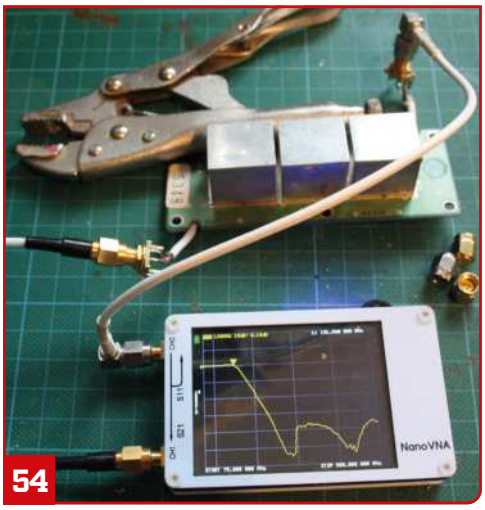
This publication is printed by Warners 01778 395111

60

Cover Story

24

Welcome



The Annual Feast of Listening Guides

Hello and welcome to the February 2021 issue of *RadioUser*. At the time of writing, Covid-19 is back with a vengeance and many continue to remain indoors to isolate, shield or just stay safe. This includes me, and, like some others, I have found it easy to justify new radio-related purchases, to beat the lock-down blues.

Here at RadioUser HQ, however, we are far from blue, and keen to bring you what I hope is another diverse and interesting issue of the magazine for your enjoyment.

The outstanding feature this month is the RadioUser annual review of the main listening guides, frequency directories and DXing publications, which is normally due in March, but which I have moved forward by a month, to help you fill your time with some interesting radio listening.

Some of us may care less about the actual broadcasts received, and the thrill is all in the 'hunt', in finding out about propagation, and so on; for others, what we hear, by whom and when, is of the utmost importance and gets logged assiduously. Whichever category of radio enthusiast you belong to, I hope you will find something in these guides, and in our pages, to keep you engaged. For airband enthusiasts, we have also included a review of Rick King's 2021 edition of the UK Airband Frequency Guide. If you use any of these publications, please feel free to share any new and exciting discoveries with our readers, by writing to either me or to our columnists.

In our other key features this month, David Harris introduces the art and science of radio audience measurement, while Keith Hamer, Garry Smith and Andrew Thomas are your guides to three important radio organisations in both the UK and Continental Europe: The UK Radio Astronomy Association (UKRAA), the European Broadcasting Union (EBU and RAJAR.

In our historical excursions this month, Scott Caldwell helps us to learn more about the fascinating figure of Edwin Armstrong, dubbed the 'father of FM'; and Geoffrey Evans takes us on an exhilarating electronic ride through the world of the transistor, without which so much in our present radio world would be impossible.

In our regular columns, Tim Kirby provides a handy beginners' guide to amateur radio, with compliments to my editorial blood brother at *Practical Wireless*. Moreover, this month you can choose to learn more about Gatwick Airport, ground-tracking at airports, short wave and global crises, hyperbolic maritime radio navigation, aerial modelling, and radio for foodies.

Furthermore, Kevin Ryan reviews the Pure Elan Connect+ receiver and Stig Hartvig Nielsen offers the latest version of his list of European private short wave stations. Add to this a full News and Products section, and I hope that the magazine is going to keep you busy and entertained for another month.

As ever, happy listening, stay safe and stay in touch.

Georg Wiessala
Editor, *Radio User* Magazine
www.radioenthusiast.co.uk

What's New

Have you got something new to tell our readers about? If so, then drop a line to **wiessala@hotmail.com**

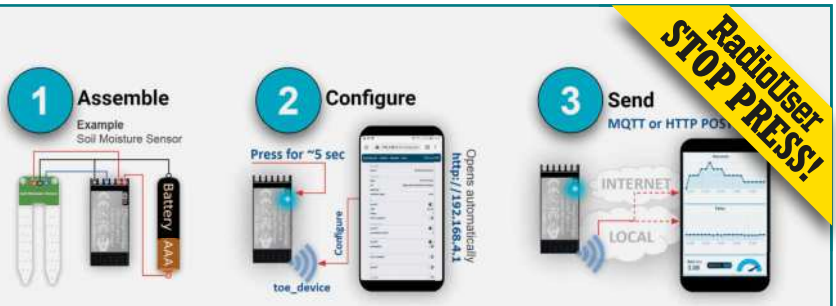
Boxchip S900A+ Network Radio

This mobile phone/transceiver is a hybrid android radio that allows 100% coverage, via 3G, 4G, LTE, Wi-Fi, VHF or UHF FM analogue, and DMR Tier II. You will always be connected. Don't know local repeaters? That is not a problem! The Boxchip S900A+ will find the repeaters. Connect to *Brandmeister* via IP. Just use your 4G or Wi-Fi and connect directly to your favourite *Brandmeister* channel. No matter where you are in the world, you will always be connected! It is a Gateway to *Zello*. Do you want to have your own RF <> Zello gateway repeater? The Boxchip S900A+ will do the job for you. Don't need to mess around with cables, crosslink boxes or complicated setups. It runs Android 9.0 so you can install any app you want from *Google Play*.

info@network-radios.com
www.megahertz.shop
www.network-radios.com
www.ptt4u.com

ISS RESOURCE: The link below contains more than one would ever wish to know about the International Space Station (ISS) and communications: SPACECOMMS by John, KG4AKV, Raleigh North Carolina, United States is the destination, in particular, for ISS SSTV hints: (SOURCE: Bob Houlston G4PVB).

www.tinyurl.com/isstvhints



IOT Cricket: Update

Further to our news item in *RadioUser*, January 2021: 7: if you would like to build your own IOT devices which could transmit data to phones or other services over Wi-Fi or the Internet? Then the *IOT Cricket* may be for you. The *IOT Cricket* Wi-Fi module is a plug-and-play device, which can be easily integrated to various IOT end nodes such as alarm systems (window, door), smoke detectors, temperature sensors, humidity sensors, leak detectors, buttons, switches, and so on.

Once you integrate it to a device, it is ready to send data either locally within your Wi-Fi or globally over the internet to your smartphone/laptops. It can be powered directly with batteries, and for a very long time. On top of that, you do not need to write any code for it. *Thingsonedge* are a small start-up based in Cambridge, UK, designing an easy-to-use, ultra-low-power Wi-Fi module for electronic device makers, scientists and hobbyists. The firm has developed several projects and published them as blogs. Have a look at the following ideas: Door sensor • Doorbell • Flower sensor • Motion sensor • Remote button (URL and e-mail contact below).

http://thingsonedge.com
sylwester.bala@thingsonedge.com

ICOM: AH-705 HF/50MHz Automatic Antenna Tuner

Icom has announced details of its forthcoming portable automatic antenna tuner for the ICOM IC-705 Transceiver. The AH-705 is a palm-sized portable antenna tuner that has been designed to work between the 1.8-50MHz bands. It can be powered either by alkaline batteries or DC 13.8V supply. These are some of the key features of the ATU: Covers the 1.8MHz to 50MHz bands, using a long wire element; 2-way power sources using alkaline batteries or 13.8V DC (13.8V DC should be taken directly from an external power supply, not through the IC-705) . Latching relays used for saving power consumption • IP54 dust-protection and water-resistant construction for outdoor use. Compact design that neatly fits in the optional LC-192 multi-function backpack.
(N.B.: This is *preliminary* information).

www.icomuk.uk
sales@icomuk.co.uk

New at Nevada: Tecsun PL-330

Nevada has a new Tecsun PL-330 short wave radio arriving later this month. It is a portable world band radio with DSP and SSB reception, covering FM (stereo), long, medium and short wave. Synchronous detection technology is available to suppress adjacent channel interference. The Easy Tuning (ETM) functionality has a radio frequency schedule function, making tuning more convenient and faster. The radio can store up to 650 frequencies manually, semi-automatically, and fully automatic (ATS), of which 100 are for FM/long wave, 150 for medium wave, and 300 for short wave. The radio has an external antenna jack, measures 139×85×26 mm and weighs ca. 210g (without lithium battery). The radio will cost £89.95. Chrissy Brand will be reviewing this new portable in full in *RadioUser* in one of the next issues.

www.nevadaradio.co.uk
www.hamradiostore.co.uk

Enter our competitions at www.radioenthusiast.co.uk/competitions

TinySA Spectrum Analyser

This new spectrum analyser has been reviewed very favourable in the radio press, not least on account of its price tag (US$ 50-60), when compared to other models (see, for example, Bob Grove W8JHD, in *The Spectrum Monitor*, January 2021). It shows signals in the range between 9kHz to 960MHz and offers an inbuilt signal generator in the same range. The device comes with an internal rechargeable battery, USB cable, software, aerial, SMA cables and an SMA adapter. According to the website, it offers the following key features • Display resolution 320*240 pixels • Screen diagonal 2.8" • 16 bits per RGB pixels • Resistive touch control • Jog switch control • USB serial port control • Optional TTL USART port (SW not yet implemented) on the internal PCB • Linear power supply to avoid switching noise.

www.tinyusa.org

Radio News

BBC RADIO MAKES A DIFFERENCE: BBC Local radio is relaunching the *Make a Difference: Give a Laptop* campaign to help provide access to laptops and devices for children and young people in need. The network is asking for people with old laptops or tablets to donate them to help pupils still in need of a digital device.

From today, all 39 local radio stations launched the campaign on-air by providing details of specialist charities across the country that will safely wipe donated devices before distributing them to local schools.

Chris Burns, Head of BBC Local Radio comments, *"Community is at the heart of everything we do across local BBC radio and I am so proud that our teams are once again uniting communities through this fantastic initiative. Everyone has a right to education, and it has never been more important for all children to have access to the same opportunities. Throughout the pandemic, our listeners have shown time and again just how big an impact we can all make, and by coming together once more to donate unwanted laptops, tablets and devices we will be able to help many more schools and families in need."*

For more information on how you can get involved in the BBC's *Make A Difference: Give a Laptop* project, visit the *Make A Difference* website:

https://tinyurl.com/yyfvxaay

BREXIT: More than 40 UK radio stations will no longer be available to Sky's Irish customers, the company has confirmed.

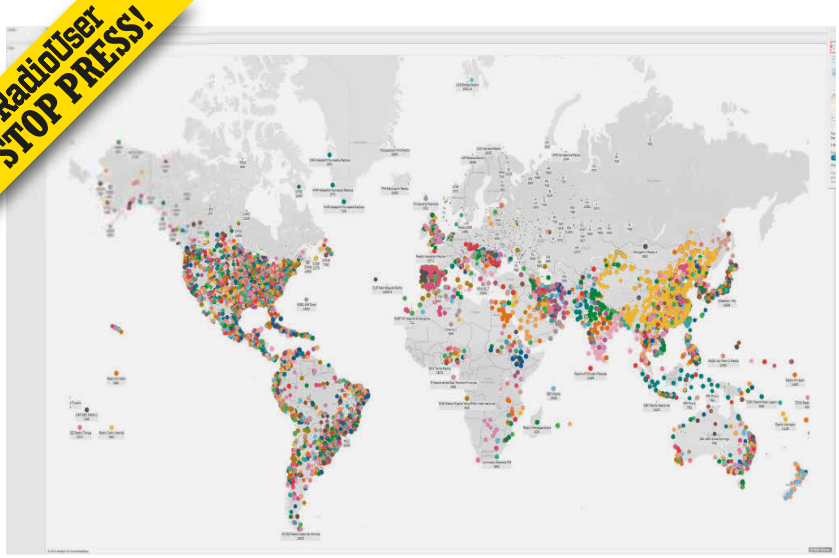
The loss of the channels is due to Brexit, with certain stations choosing not to obtain an Irish/EU licence to operate after the UK leaves the European Union (EU).

The changes came into effect on 21 December 2020 and mainly affect commercial radio stations ,including those owned by Bauer, *Global* and *Wireless* in the UK.

(SOURCE: via Chrissy Brand, with thanks).

www.dublinlive.ie

RadioUser STOP PRESS!



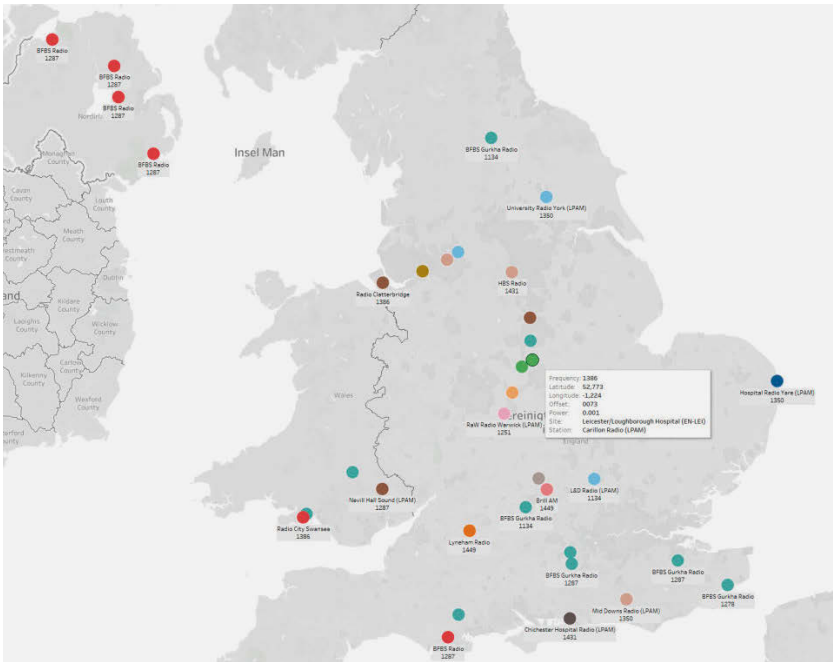


Tableau Visualizing MWLIST

Broadcasting on medium wave is still a very active part of using the electromagnetic spectrum. A unique and outstanding source of information is supplied for free by MWLIST, a team of smart DXers. They provide tons of up-to-date and precise information – down to exact locations and even offsets from the nominal channel. By visualizing this data, you get an even better insight. Here, free Tableau Public software is (for me) the tool of choice to do just that – please see the screenshot on top of this page. You simply download the free Tableau app and sign up (for free), and you are done. For me, the most striking feature is the visualizing of the spatial data, i.e. showing the transmitters at their proper place on a map. Another welcome feature is filtering the data to answer specific questions like *How are traffic broadcast stations above 1.6MHz spread over Pennsylvania? What can I expect listening on 1521kHz on a late winter afternoon in Europe? Where are Chinese stations located, carrying the CNR1 programme of China National Radio?* You will find screenshots illustrating these examples on Nils Schiffhauer's website, below. (SOURCE: Nils Schiffhauer DK80K).

https://tinyurl.com/y6afqzk5

Radio News

LONDON SHORTWAVE: This blog carries an interesting article on ultra-portable short wave spectrum capture with the Belka-DX and a Zoom H1recorder. Worth reading if you are monitoring out and about a lot with your portable gear.

https://tinyurl.com/y5tq2xrb

TU RADIO REGULATIONS 2020 RELEASED: The ITU has made its *Radio Regulations 2020* available as a free download. The *ITU Radio Regulations* exist in order to facilitate equitable access to and rational use of the natural resources of the radio-frequency spectrum and geostationary satellite orbits.

These rules also ensure the availability of the frequencies provided for distress and safety purposes and assist in the prevention and resolution of cases of harmful interference between the radio services of different administrations.

Further, the regulations facilitate the efficient and effective operation of all radiocommunication services and, where necessary, regulate new applications of radio communication technology.

(SOURCE: ICQ Amateur / Ham Radio Podcast, Colin Butler).

https://tinyurl.com/y25h9y33

AUSTRALIAN MW BROADCAST STATIONS: Tecsun Australia has out an A-Z table of medium wave broadcast stations on the Continent at this URL:

https://tinyurl.com/y62kxhnk

NEW CHAIR: Richard Sharp is the Government's preferred candidate for the BBC Chair, the Culture Secretary Oliver Dowden has announced. Mr Sharp, a former Chair of the Royal Academy of Arts with a background in finance and public service, has been selected following an open and rigorous competition and in line with the Governance Code. He will bring his experience in global commerce, the creative industries, and in public service to lead the BBC Board, supporting the Director-General to deliver the BBC's Mission and Public Purposes in the fast-changing media landscape. Remuneration for the new BBC Chair will be £160,000 annual salary for 3 to 4 days per week. Mr Sharp will now appear before MPs on the Digital, Culture, Media and Sport Select Committee for pre-appointment scrutiny on 14th January 2020. He is expected to take up the post at the end of Sir David Clementi's term in February. Culture Secretary Oliver Dowden said: "Richard's leadership in the top flight of finance and commerce, combined with his passion for culture and public service make him the ideal person for this hugely important role. *"He is exactly the Chair the BBC needs right now. I'm confident he will drive forward reforms to the BBC to ensure it impartially reflects and serves the needs of all parts of the UK and evolves to remain a global success that is central to British national life in the decades ahead."* Richard Sharp said: *"The BBC is at the heart of British cultural life and I'm honoured to be offered the chance to help guide it through the next chapter in its history."* Under the terms of the *BBC Royal Charter,* the appointment of the BBC Chair is made by The Queen through Order in Council on the recommendation from ministers (the Secretary of State for Digital Culture, Media and Sport, through the Prime Minister). Ministers were assisted in their decision-making by an Advisory Assessment Panel which included a departmental official and a senior independent panel member approved by the Commissioner for Public Appointments.
(SOURCE: BBC, National Press, Radio Today).
https://tinyurl.com/y3mw866n

FM RADIO ON JUPITER, BROUGHT TO YOU BY GANYMEDE: In a recent research paper, Louis *et al* have presented some exciting new observations of radio emissions on Jupiter from the NASA Juno spacecraft – the first direct detection of decametric radio emissions originating from its Moon Ganymede. These observations were made as Juno crossed a polar region of the Giant Planet where the magnetic field lines are connected to Ganymede. The radio emissions were produced by electrons at relativistic energy (a few thousand electron volts) in a region where the electron's oscillation frequency (its 'plasma frequency') is much lower than its gyration frequency (the 'cyclotron frequency').
Such electrons can amplify radio waves close to the electron cyclotron frequency very rapidly, via a physical process called Electron Cyclotron Maser Instability (CMI). They may as well produce aurora in the far-ultraviolet – which was also observed by the camera on Juno. Juno was travelling at a speed of approximately 50 km per second, and it spent at least about 5 seconds crossing the source region of the emission, which was therefore at least about 250 km in size.
The observed decametric radiation on Jupiter is the 'shorter cousin' (in wavelength) of the auroral kilometric radiation on both Earth and Saturn: the CMI being responsible for their production on the three planets.
(Source: AGU Editor's Highlights; *Geophysical Research Letters).*
https://tinyurl.com/y4wmanre

HULL AND DISTRICT ARS CELEBRATES 100 YEARS: This year, the Hull and District Amateur Radio Society is celebrating a centenary of radio clubs in the city of Hull. The first evidence of a radio club based in the city comes from a petition presented to the Postmaster-General by the Amateur Radio Telegraphists of Great Britain in December 1921. The documents were signed by representatives of 64 groups including the President and Honorary Secretary of the Radio Society of Hill and District. Since 1921, there have been various radio clubs based in Hull; the current club was established in July 1952. The club is arranging several events to recognise this occasion, including visits to various interesting places; a major one-day event to celebrate the centenary; a special event station callsign for the year; a special QSL card; participation in various contests, and other events
(Source: *ICQ Amateur / Ham Radio Podcast*, 4th January 2021; Colin Butler).
http://hadars.co.uk

The Art and Science of Measuring Radio Audiences

David Harris
mydogisfinn@gmail.com

David Harris investigates the methods and functions of the Radio Joint Audience Research (RAJAR) corporation, looking at the compilation and interpretation of the latest radio listening statistics in the process.

Accurate listener statistics are essential for commercial radio stations who obtain all of their revenue from advertising. If you are an advertiser you want to know how many listeners you are getting for your adverts, to justify the expenditure of a radio campaign. This is even more important today in our multi-platform world, where social media is taking up to 30% of all advertising spend. In the UK in 2019 commercial radio advertising revenue was worth over £700 million.

It seems as if the BBC is constantly fighting a battle for survival and needs to be able to justify the licence fee by showing that it has respectable listening figures. This will be even more important in the years to come with the BBC fighting against what many see as a libertarian, populist government, many of whose members would like to see the BBC sold off, closed down or reduced to a very minor role.

Radio Joint Audience Research (RAJAR)

One of the casualties of Coronavirus has been the quarterly release of radio listening statistics from RAJAR. **R**adio **J**oint **A**udience **R**esearch is a not-for-profit company set up in 1992; it is jointly owned by the BBC and Radio Centre, the body representing commercial radio stations in the UK. Previously, radio statistics had been compiled by the Joint Industry Committee on Radio Research (JICTAR); and before that, the BBC and commercial stations did their own research.

One of the reasons why RAJAR has been off the air is the fact that it uses largely paper-based listener diaries to record listening activity. RAJAR has around 100,000 correspondents, only some of whom use an online recording system. In some countries, there are more sophisticated ways of recording listening habits. However, in the UK the technology has not been available to improve on the present system of correspondent input. The day-to-day management of RAJAR statistics is contracted out to IPSOS-MORI, a major market research company formed in France in 1975. In 2005, they took over the British MORI company. The RAJAR website states that reporting has been frozen at Q1 2020 until fieldwork can recommence.

At the time of going to press the latest RAJAR figures were for Q1 (Jan – Mar 2020).
https://tinyurl.com/ybn9lf98

These figures, due to their large sample size, do not vary hugely from quarter to quarter. What is important are long-term trends. Radio listening in the UK is alive and well, with 89% of people listening to the radio for some time each week. This figure seems to be holding steady and has not changed much over the last 10 years. We are constantly being told that young people only stream music, don't own a radio and do everything on their phones – yet the statistics show that this is not the picture.

This level of listening is slightly lower than in other Western countries. Daily listening figures show that Slovenia and Ireland have figures of 65%. The lowest listener figures in Europe are in Romania, where only 27% of people tune in each day. The UK daily figures are only 51%, according to Statista. Other figures show that 87% of EU citizens listen to the radio at least once a week. In the USA, the figure is 92%.
www.statista.com

The BBC in Uncertain Times

The BBC has for most of its existence been fighting critics from both the left and

the right. The onslaught against the BBC has been building up for some years on the right-wing of politics, yet it remains very popular and reaches 61% of the population. BBC listeners clock up over two listening hours a day. In September 2020, Timothy Douglas Davie CBE took over as the 17th Director-General of the BBC. He has a very tough job in trying to take the BBC forward at a time of great political and technological change.

https://www.bbc.co.uk
https://tinyurl.com/y89ssuvu

Therefore, RAJAR figures will be an important resource in helping him make decisions as to which services need to be cut back or closed altogether. The listener figures for BBC stations show huge variations between stations.

RAJAR uses two main indicators: (1) *Reach* (the total number of people who listen for at least one 15-minute period each week). (2) *Share in TSA* (the percentage of overall listening time in the *Total Survey Area* (TSA) for the station). The TSA, in turn, is the location within which a station's audience is measured; it is defined by the station, using postcode districts as 'building blocks'.

https://tinyurl.com/yas926yc

The figures currently available reveal that BBC Radio 1 is in decline with a reach of 16% and a TSA share of 5.6%, down from 9.9% in 2009. Radio 1 must be vulnerable to any privatisation of BBC services. Radio 1 is also in direct competition with many commercial stations, and, for some, it may be difficult to justify what public service remit it actually fulfils. BBC Radio 2 remains Britain's most popular national station with a reach of 26% and a 16.3% TSA share, which has remained fairly steady over the last 10 years.

Radio 2 has been held up as a model of public service broadcasting as it neither too 'serious' nor too 'populist'. The station seems to be able to satisfy the listening needs of a large number of mainly older people.

BBC Radio 3 only has a reach of 4% and a TSA share of 1.3%. This has been steady over the last 10 years. Many European countries have a state-funded cultural radio station that plays mainly classical music. In the UK, Classic FM broke the mould by showing that a commercial station can play something other than bland pop and still make money. Classic

FM has a 10% reach and 4.2% TSA share.

BBC Radio 3 has been the jewel in the BBC's radio crown since it was established in 1946 (as the *Third Programme*). It does cost a lot to run and has a small audience. BBC Radio 4 has a 20% reach and 11.7% TSA share – which again has not changed that much over the last decade. Radio 4 is the model of a state broadcaster and provides not only news but drama, comedy, documentaries, and religious programming.

Newcomer Times Radio (DAB only) was launched in June 2020 and is not included in Q1 RAJAR figures. It will be interesting to see what sort of listening figures this new station, positioning itself against Radio 4, can achieve. BBC Radio 5 has a 9% reach and TSA share of 3.5% – down from 5% in 2009. Radio 5 is up against talkSPORT, with 5% reach and 2% TSA share. Radio 6 (digital-only) achieves a 5% reach and 2.4% TSA share. This makes it the most popular DAB-only station.

Commercial and Local Radio

The commercial radio arena is now firmly controlled by three large media groups: Bauer, Global and Wireless (Richard Murdoch). It has a reach of 66% and a TSA share of 47.8%, up from 42% share in 2009. In the UK, we have seen an almost total consolidation of commercial radio. However, there are still no clearly-defined national commercial stations, except for Classic FM (Global), talkSPORT (Murdoch) and Absolute (Bauer).

Bauer has recently rebranded most of its newly acquired stations as "Greatest Hits" or "Hits" (both, in my opinion, really weak brands). Global does not quite have a national network but it does possess very strong brands with Capital, Heart, and Smooth. The most popular commercial station is Heart, with a 6% TSA share.

BBC local radio has a TSA share of 6.3% nationally, but there are huge variations across the country. BBC Shropshire, for example, has 11.6% TSA share but BBC Wiltshire has only a 2.4% share. BBC Radio London, at 1.1%, looks like a candidate for the axe. The BBC regional stations vary with Radio Ulster getting 19.3% TSA share, BBC Scotland manages 6.7%, and BBC Wales is at 5.9%.

As an organisation, RAJAR seems keen to promote digital listening. In Q1 2020, 58% of all radio listening is now digital. Of that share, 69% is via DAB, 8% via TV platforms and 24% online (smartphone, PC or smart speakers). Phones, PCs and smart speakers are becoming more popular ways of sourcing radio content. However, are people just listening to what they could hear on an FM radio?

The failure of DAB-only stations to gain much market share suggests that the main selling point of DAB – more choice of stations – is not really what the public wants. I fear that high-quality, easy-to-access FM radio may be forced to close (as it was in Norway) to enable the broadcasters to save on transmission costs.

RAJAR does not include Community radio stations as they would not be able to afford the subscription fees. Community stations can only get 50% of income from adverts, and many of them use subscriptions or donations to fund services. RAJAR recruits correspondents by knocking on people's doors and selecting a representative cross-section of the population; one cannot volunteer to join RAJAR.

I wonder if any RadioUser readers are RAJAR correspondents? If you are, please let us know. One hopes that it will not be too long before RAJAR returns, and the quarterly statistical overviews become available again

www.rajar.co.uk

[This is an expanded version of an article which first appeared in Communication *(the journal of the British DX Club* ***www.bdxc.org.uk****; any opinions expressed are those of the author – **Ed.**].*

Related Resources

- IPSOS-MORI
  https://www.ipsos.com/ipsos-mori/en-uk
- Radio Centre
  https://www.radiocentre.org
- RAJAR
  www.rajar.co.uk

Annual Frequency Handbooks and Listening Guides

David Harris
mydogisfinn@gmail.com
Georg Wiessala
wiessala@hotmail.com

David Harris and the editor take a critical look at the new vintage of the radio enthusiast's favourite frequency manuals and listening guides published at this time of year.

The Global Radio Guide (GRG)

Having bought your copy of *WRTH 2021* (£35) and *Radio Listeners Guide* (£7), you will still have change from £50 to buy the *Global Radio Guide* (£6.70). I think that you will then have all the essential publications needed to get the very best out of your radio listening.

The *Global Radio Guide (GRG)* has fast become an essential publication since it was founded in 2014 by ex-Monitoring Times writer Gayle Van Horn W4GVH. The GRG represents two books in one. The first part is a collection of very informative and up-to-date articles about different aspects of radio. We kick off with a survey of the Tropical Bands (Gayle includes the 49-metre band as well as the 120-, 90-, 75-, and 60-meter frequency allocations) We learn about how these once busy bands with their exotic music can still provide interesting catches for the determined DXer.

The author then looks at how international broadcasting via satellite has to some extent replaced short wave broadcasts. China, Russia and France are major players in global satellite broadcasting, allowing both TV and radio streams to be picked up worldwide.

There is a brief look at music on SW radio, focusing on stations such as WRMI and Radio New Zealand who play a wide variety of music. The GRG also offers a well-researched-essay on how radio took off in 1922.

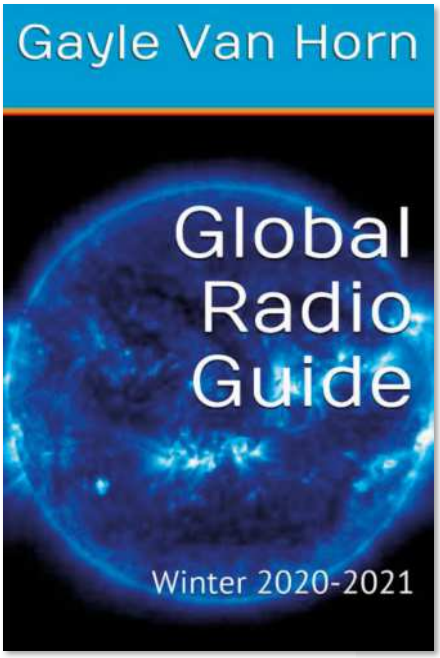
There is a lengthy article on Very Low Frequency (VLF) monitoring which includes: NAVTEX; Non- Directional Beacons; submarine communications; time signals and natural sounds.

If you are contemplating buying an SDR radio, the GRG offers a 24-page review of most current models from RTL Dongles, which start at around £20, up to the Winradio Excalibur Sigma for £6200. Overall, the GRG lists dozens of products from 18 different manufacturers. If you are new to short wave listening, there is an excellent introduction to the broadcast bands. Gayle's husband Larry then takes over with an introduction into what he calls the *"Action Bands"* (or utility bands) where it is still possible to listen to ships, aircraft and military communications. He provides 32 pages of spot frequencies from 2 to 29 MHz. Many of these are US military or US government listings but some should be able to be picked up in the UK. The book also has a useful Radio News section with updates on the sale of WHRI to WBCQ and the launch of Hope Radio.

There are also listings of DX programmes and an article on QSL cards.

The bulk of RLG is taken up with nearly 300 pages of hour-by-hour listings of most broadcasts, in all languages that can be heard on the MW and SW broadcast bands.

This is a unique feature which is not replicated in any other publication.



Global Radio Guide (15th edition) Winter 2020-2021
by Gayle Van Horn.
Teak Publishing, USA. eBook. 476 pp.
$8.99 (£6.70) available via Amazon
ASIN: B08PHX81Z1
www.teakpublishing.com

I take my hat off to Gayle and Larry for having produced such an interesting and wide-ranging publication on a bi-annual basis for the last eight years. There is nothing not to like in GRG; it is a first-class publication that should be on the PC, tablet, phone or Kindle of every radio enthusiast.
https://tinyurl.com/ydfg3a92
http://www.teakpublishing.com

The Radio Listener's Guide (RLG)

The *Radio Listener's Guide (RLG)* is now in its 32nd year of publication; if anything, it is more relevant than ever in the fast-changing world of British radio. RLG is part radio magazine, part consumer product reviews and part frequency and station listings.

If you wonder what has happened in the world of UK radio in 2020 then RLG begins with six pages of updates including topics such as the switch off of AM stations; the launch of Times Radio; Bauer systematically buying up and closing down local stations; RAJAR radio audience survey on hold; Ronan O'Rahilly obituary; and the expansion of small-scale DAB. Most of these stories are not reported in the national media, which makes RLG an invaluable source of radio news.

There is a noteworthy article on Greatest Hits Radio, the 'national' radio brand Bauer is imposing across the UK by buying up local stations and converting them to this bland format. Local media seems oblivious to how commercial radio in the UK is now in the hands of three mega-corporations – *Bauer, Global* and *Wireless Group* (part of Richard Murdoch's empire).

Many people will buy the RLG 2021 to help them choose a new radio. The booklet offers a further six pages of guidance on choosing a radio. This comprises of listings and specifications of 140 radios, ranging in cost from £7 to £2,300. Moreover, there are detailed reviews of 17 radios which have recently been launched in the UK. If you are looking for a new FM/DAB radio, the modest £7 price is well worth it to avoid making an expensive but

Radio Listener's Guide 2021.
Edited and published by Clive Woodyear.
2020. 162 pp. Pbk. £7.
ISBN 9781871611328
www.radioguide.co.uk

BUY FROM US! See page 18

poor purchase.

We have seen huge technological advances in home technology in recent years. If you need an update on these, the RLG has concise chapters on Bluetooth; multi-room systems; voice control; smart speakers; music streaming, podcasting, and much more. These chapters are very clearly written and should help you choose whether you need to invest in any new technology.

The majority of the content of the RLG, some 90 pages, is taken up with numerous maps showing coverage areas of main radio stations, maps of commercial and local BBC stations, and comprehensive frequency and station listings. Every single radio station (BBC, commercial and community) is listed, along with its frequency. The listings appear in both alphabetical and frequency formats. If you are in the South Hampshire area and hear a music station on 104.3 FM, for example, you will be able to identify this as the community station *The Flash*, based in Waterlooville.

You could then turn to the station listing and find that out that *The Flash* transmits from Waterlooville library with an ERP (Effective Radiated Power).

Last but not least, the RLG contains four pages of listings of Irish stations, as well as full details of the radio stations on the *Freeview, Freesat* and *Sky Radio* platforms. There are even a couple of book reviews.

No other publication in the UK at any price has the wealth of UK radio information on offer here.

World Radio TV Handbook (WRTH)

The World Radio TV Handbook (WRTH) 2021 is the 75th edition of this essential guide to global broadcasting. I think the secret of producing a successful annual publication is to get the format right and stick to it.

I think that every time one opens the latest edition of WRTH, this is like meeting an old friend.

The first part of the WRTH is where you find the eagerly-anticipated reviews of new world band radios, communications receivers and accessories.

[For the WRTH's Anniversary Edition*, most of these were provided by our colleague and regular* RadioUser Aerials Now *contributor* ***Keith Rawlings G4MIU****, WRTH 2021: 12; congratulations to Keith; many of the radios tested in the WRTH have also been reviewed in* RU *and* PW *throughout 2020 – Ed.].*

There may not be that many *new* models released, but the WRTH contains very comprehensive reviews of them all. Many radio listeners will fantasise about owning the AOR AR5700D, a wide-band 9kHz to 3.7GHz all-mode 'super-radio'. The review rates it at five stars, which seems about right for a radio costing £4,595.

For those of us with more modest budgets, the Tecsun PL-990 might fit the bill. This is an updated version of the Tecsun PL-880. This radio wins four stars, and UK importer Nevada Radio is advertising it at £260. There are also reviews of ICOM IC-7610 transceiver (£3,000), SDRPlay RSP DX SDR radio (£190) and the Bonito NT1 Mega Dipole active antenna (£430). If you are looking to buy a new world band radio, communication receiver or SDR, the *WRTH HF Receiver Guide* (p. 24) lists 15 portable and 28 desktop radios, ranging in price from £36 to £10,700. Each radio has received a 'star-rating', from one to five.

There are several interesting articles on *Development of Broadcast Transmitters; Radio in Bhutan; Coastwatchers* (radio operators working on enemy-held Islands in the South Pacific during WW2), and the (volunteer) Finnish station *Scandinavian Weekend Radio*.

On top of this, the usual 12-page world atlas, showing capital cities and locations

World Radio TV Handbook (WRTH). The Directory of Global Broadcasting 2021.
WRTH Publications Ltd. 2020. 672 pp.
Pbk. £35. ISBN 9781999830038
www.wrth.com

BUY FROM US! See page 18

of SW transmitters is, once again, a very useful feature.

The main section of WRTH comprises of 395 pages listing virtually every domestic AM, FM and DAB radio station in some 250 countries. For instance, if the article on Bhutan interested you, you will learn (p. 100) that Bhutan has a population of 830,000, and that the main broadcaster is Bhutan Broadcasting Service (BBC) who operate two services, *Main* and Radio DZ.

The programme schedule states that the station is on the air 24 hours a day on FM and has several programmes in English. These stations can be heard on 24 different transmitters throughout the country. Bhutan BC can also be heard on 6035kHz SW, and we learn that there are three other FM stations in Bhutan.

If you thought that international broadcasting was 'dead' then you are very wrong. In evidence for this, the WRTH contains 53 pages recording

"I think that every time one opens the latest edition of WRTH, this is like meeting an old friend."

Klingenfuss 2021 Super Frequency List

international broadcasters based in 86 different countries. There are also directories of clandestine and other target broadcasters who broadcast anti-government propaganda to 20 different countries. Furthermore, you will find many pages of frequency lists for all MW and SW broadcasters, DRM broadcasts, as well as a 50-page guide to terrestrial TV broadcasting.

There is simply nothing quite like WRTH anywhere in the world at any price (**DH**).

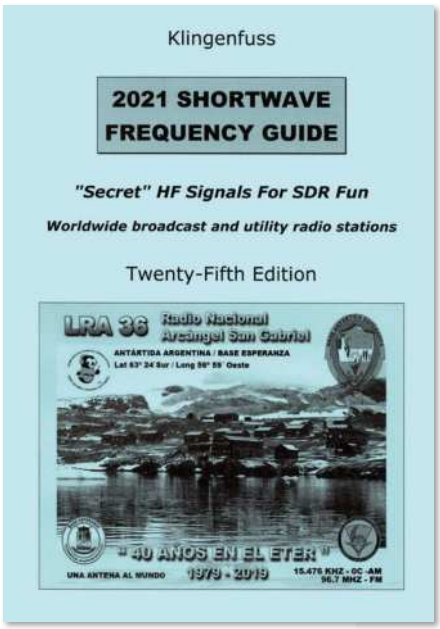
Klingenfuss 2021: Continued Growth and Diversity of Intelligent HF Communications

You know it is almost Christmas when the new *Klingenfuss* publications come out. Of this year's bundle of radio publications products from Jörg Klingenfuss in Tübingen, I had a look at the new editions of the *2021 Shortwave Frequency Guide* (25th ed.) and the *2021/2022 Guide to Utility Radio Stations* (31st ed.).

Like many others, I have been using both of those professional frequency lists, as well as other *Klingenfuss* titles, for decades -- both for short wave broadcast listening and DXing and for utility signal monitoring – as a traveller, SW enthusiast and technically-interested editor.

There were no travels this year, and it has been especially important to me to have plenty of accurate and verifiable frequency data during my much-increased DXing activity in lockdown.

The *2021 Shortwave Frequency Guide* fully address the needs of professional services, whilst also being extremely useful for DXers of all shades and intensities, and casual HF listeners.



Klingenfuss 2021 Shortwave Frequency Guide (SFG) Worldwide Broadcast and Utility Radio Stations
Klingenfuss Publications, 25th ed.,
9th December 2020
ISBN 978-3-941040-71-7
344 pp.; pbk. €40

Klingenfuss 2021/2022 Guide to Utility Radio Stations (GURS) Professional HF Communication Today
Klingenfuss Publications, 31st ed.,
9th December 2020
ISBN 978-3-941040-21-2
544 pp.; pbk. €50

Do not overlook the excellent, thorough, introduction to utility stations, including aeronautical, meteorological, maritime and more; and absorb the screenshot-seasoned pages on equipment, modulation and demodulation, reception, propagation, and Web-SDRs – the latter, it seems, a particular interest of Jörg's for some years now. It is in this general opening section where you will find better background information than in many an official textbook on these subject areas.

This is followed by a thoroughly-researched and clearly-presented utility frequency listing, taking us from pages 44 to 194. The broadcast stations list has a brief overview of rapidly-vanishing DRM broadcasts, followed, more pertinently, by details of short wave transmissions from 3185 to 21800kHz.

These show frequency, callsign, station, ITU classifier, mode, and further details.

This list is capped by useful alphabetical lists of stations. Notice, to name just one example, the many frequencies taken up by radio-hegemon China – this is where censorship meets radio freedom.

https://tinyurl.com/ya5sfths

Here, you can also sample, at your leisure, screenshots and ancillary information on sites, acronyms, languages, destinations and names.

A taster from this section is shown on this page and can be found – together with many others – on the Klingenfuss (*.pdf* and *.gif*) full-size sample pages website:

https://www.klingenfuss.org/pdfiles.htm

The *2021/2022 Guide to Utility Radio Stations* is now in its 31st incarnation and takes us into 2022. It links in with other *Klingenfuss* products and package deals, such as *CD Recordings of Modulation* Types, the professional-level *Digital Data Decoder Screenshots on a USB stick*, or the *2021 SFG* (above).

https://www.klingenfuss.org

Much like the SFG 2021, GURS 2021/2 benefits from an extremely informative introduction, which includes background data on such topics as the legality of monitoring, on individual users like HF e-mail, public safety and peacekeeping, and on general matters, for instance, types of modulation, and the use of online SDRs. I particularly enjoyed the sections on automatic monitoring and direction-finding with wideband SDRs, for example, the *Kiwi-SDR* infrastructure.

www.kiwisdr.com
www.ve3sun.com/KiwiSDR

(András Retzler HA7ILM)

The 2021/2 GURS main frequency list has, once again, an unrivalled span

from 20 to 30000kHz and is followed by an alphabetical list from Afghanistan to Zimbabwe, callsign lists, and – always my favourite – content on weather radio via RTTY NAVTEX and Weather Facsimile (WXFAX). Digital data transmissions are introduced and follow from pages 368 to 472; the many instructive screenshots, here and throughout the book, are a great resource and will keep you busy for years.

The volume closes with extensive information about 'Q' and 'Z' codes, the SINPO scheme, aeronautical and maritime mobile service frequency allotment plans, classes of stations and nature of the service, terms and definitions, acronyms, and much more. Check out the well-hidden two pages on actual Global Radio Monitoring operations – what an eye-opener.

As before, *The 2021 Super Frequency List* brings it all together and expands, through 37,300 worldwide HF listings, the value of the *Klingenfuss* books, mainly through enhanced coverage, more digital data decoder screenshots, and extensive, fast, search options.

In some areas, short wave radio transmissions– of this there can be no doubt– continue to be on the rise worldwide, be it in utility, scientific, military and clandestine contexts, through digital HF networks and digital utility station radionets, via SailMail, Bushmail, HF-Email, emergency and disaster communications, or employing utilizing online SDRs or other relatively new channels.

And remember, at no time have we had such a broad spectrum of technologies and means to receive and decode (many of) these transmissions, with a minimum of effort.

At no other time too, has it been so important to stress that *the internet cannot replace short wave*. SW is free to listen too, available to all without 'digital divide', 'cookie-free', 'terrorist-' and revolution-proof (to quote JK, 2021 SFG: 205); and, as opposed to the world-wide-web, it cannot be 'filtered' or switched off.

It bears repeating as well that one-quarter of the world's population have neither electricity nor computers, let alone internet access, as much as this number may be decreasing over the next few years.

There is one more vital point, which we have recently highlighted in this magazine (C. Brand, *RadioUser*, December 2020: 20). In our confused age of 'fake news', it is becoming much harder to sort the wheat of reliable news from the chaff and fog of social media and deliberate online disinformation.

To be sure, there are many subtle propaganda campaigns, frequency-takeovers and hidden ownership structures in numerous places; short wave radio is in no way a *panacea* against these, as the examples of oppressive and authoritarian governments worldwide continue to show.

However, there can also be little doubt that the HF medium offers a much broader, more balanced – and growing – option of more resources, ideas and facts to help you make up your own mind.

It seems to me that this is, in fact, the best rationale for acquiring a book like this one, rather than falling prey to *"the politically correct nonsense in the brain-washing global mass media"* (JK, 2021 GFG: 16).

One more point needs emphasising (nd I quote the publishers directly here because this is so important, 2021 SFG: 205):

"Now consider the absurd decision by leading international broadcasters to drastically reduce their worldwide short-wave transmissions, or to shut down HF completely! Under the difficult situation described above: just how do BBC, DW, VoA and then like get the message – and mission – across the border to the poor people that is [sic] most in need of independent information – and international support".

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Radio News

MOORE'S LAW AND SHANNON'S LIMIT: This *Electronic Engineering Times* Podcast (*EE Episode 116*) *Close to the Edges: Moore's Law & Shannon's Limit is* well worth a listen: The power and speed of electronic systems in the past 50 years have grown at an incredible pace. Integrated circuits in the 1960s contained thousands of transistors; now they contain billions. At the beginning of the internet era, a fast datacom connection was measured in thousands of bits per second; today, parts of the network transmit data at terabits per second. The increases in power and speed in our datacom networks have been predictably inexorable. We've known for a very long time, however, that we're going to approach limits. Processing power depends heavily on the number of transistors you can bring to bear on a problem. In 1965, Gordon Moore published a paper predicting that the number of transistors in a given area of silicon would roughly double approximately every two years. That would be accomplished by making transistors smaller and smaller. That's Moore's Law, which is famous enough that a very large proportion of non-engineers have heard of it. It was commonly understood that Moore's Law would eventually hit a limit. There would be a physical limit to how small you could make any feature on silicon, and after that, further integration on silicon would be impossible. Less well-known, but no less important, is a theorem devised by Claude Shannon and Ralph Hartley that predicts an upper limit on the amount of information that can be transmitted in a given amount of time on a communications channel, considering noise. It means there is a limit on data transmission rates – a limit, basically, on how many bits per second you can transmit. That theorem is referred to as Shannon's Limit. It just so happens that the industry is simultaneously approaching the limits to both silicon device integration and communications channel capacity – to both Moore and Shannon. Listen to the full podcast here:
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RADIO CORONA INTERNATIONALE

1

Pandemic Programme Panache

Chrissy Brand
chrissyLB@hotmail.co.uk

Chrissy Brand looks at how the radio industry continues to cover, and work around, the current Coronavirus (Covid-19) pandemic. She also reflects on recent radio award winners and sounds from space.

The rolling out of Covid-19 vaccines brings hope to us all, but the effect of the pandemic also resulted in some positive new ways of working in the broadcasting industry. Working from home became the norm for many people in 2020, with some radio programmes being presented from makeshift studios, in kitchens, sheds or even under the duvet. Not everyone has a spare room or home office that they can set up in.

Bird in the Sky is a BBC Radio 4 docudrama made last summer. It told the true story of US Air Force mechanic who stole a transporter plane to fly home. Actor Julianna Jennings recorded it in her broom cupboard in the French Alps, while co-star Adam was under a pile of cushions and a duvet in his bedroom. Broadband connections and domestic noise, from neighbours and appliances, have made it difficult to always retain the required levels of professional quality.

Radio TechCon

As we all know, the pandemic has led to ways of interacting which would not otherwise have evolved for another few years. Video conferencing has become mainstream. We can attend meetings for work, public campaigns and social interaction from book groups to pub quizzes; besides, many people who do not venture out due to mobility issues or avoiding the winter weather can connect with the world. We can even attend recordings of radio programmes as well.

The annual Radio TechCon gathering, usually held at the IEEE in London, took place instead online, on November 30th.

Fig. 1: Radio Corona Internationale is online from Rhode Island. Fig. 2: Looking at Arabic text display on DAB and DRM at *Radio TechCon*. Fig. 3: Sounds from space with a NASA audio engineer. Fig. 4: Student Radio has reported on empty libraries and isolated students. Fig. 5: The *Radio 0000* app is a veritable 'music time machine'.

The conference ran using *Adobe Connect*. This is another software solution used to link people from all over the world and share presentations, video, audio and ideas. There were also 'breakout-rooms', where delegates could chat with exhibitors and sponsors and network with each other.

I was delighted to attend, even more so when a package was sent in advance, containing conference programme, cake, refreshments and a 'goodie-bag' of a pen, coffee cup and memory stick. It was a fantastic effort to recreate the friendliness warmth and inspiration that this conference always brings.

Matthew Page, of *BBC Outside Broadcasts*, gave a presentation that was titled *The Internet Monkey Cage*. This was a fascinating glimpse into how the BBC created its own live audience platforms to cope with Covid-19. Building a virtual live audience tool enabled people to virtually attend radio and television shows, from last June onwards.

BBC Radio 4 entertainment and educational programmes such as *The Infinite Monkey Cage, Just A Minute* and *Gardeners' Question Time* have been able to move back towards a sense of normality, with live audience reactions included, just as in pre-pandemic times – well, almost.

Robin Ince, a co-host on *The Infinite Monkey Cage*, was concerned that this innovation might sound as if the audience were disconnected but, speaking at *Radio TechCon*, he said that this did not happen. He felt that the technology created a better level of intimacy and interactivity with guests for the show and that he does not want to go back to the old ways. Presenters, guests and presumably, most audiences, have quickly mastered the technology.

There were many other fascinating presentations. For example, Wolfgang Rein, of German broadcaster *Südwestrundfunk*, talked about improving a station's studio output and distribution with loudness metering and workflows. He illustrated this using the youth channel DASDING (coll.: 'The Thing'), which plays mainstream and alternative music genres. However, the station also has features on psychology, health, dating and gaming.

Broadcasts and Systems Engineer, Chris Thame, spoke about launching Times Radio during the pandemic. This required converting a TalkSPORT 2 studio. It involved putting in a new LED wall and changing from a single desk space to the double desk studio required for Richard Murdoch's Times Radio to take to the airwaves. This was clearly a challenge, keeping in mind the need for social distancing during the work, and also for when more than one presenter uses the small studio.

How to display Arabic text on DAB and DRM was something many of us have not considered before, but in a presentation titled *DAraBic* (Fig. 2), BBC World Service Strategist Abdallah al-Salmi addressed developments in this area.

Ways of handling Arabic script on digital radio is something that needs to be figured out. Other languages such as Urdu, Persian and Hindu all scroll from right to left, unlike the left-to-right direction of Latin and Cyrillic.

You can follow Abdallah on Twitter @AbdallaBBC.

Alexandria Perryman is an Emmy-award winning audio engineer for NASA, in Houston, Texas (Fig. 3). In her talk on *It is Rocket Science, how NASA Does Sound*, she explained the joy of mixing audio from space for NASA's YouTube, Instagram Live and Facebook Live channels. Part of this work is done using a 25-year old studio mixing console.

Other highlights in her career, so far, have included overseeing Garth Brooks splaying his music to astronauts and Brad Pitt in a Q&A for an acting role. You can hear more of Alexandria's work in the podcast she produces from the Johnson Space Center, called *Houston We Have a Podcast*.

And The Winner Is...

The Association of International Broadcasters (AIB) were all set to host their 16th annual gala dinner and awards ceremony in plush new surroundings near Westminster, but, of course, this was put on hold. Instead, the AIB 2020 Awards took place online on November 13th and 16th; they can be watched at the AIB website.

The 2020 Student Radio Awards also took place in November. With lecture and library access limited, due to Covid-19 (Fig. 4), and with a 2021 rent strike gaining momentum, student radio now has a very good platform for wider exposure in 2021. In addition, student radio is a vital space for future generations of radio broadcasters. The awards showed that the student radio landscape is in good shape. This was further evidenced by the fact that fifteen former student radio broadcasters or alumni took over BBC Radio One at Christmas time, presenting programmes that included *The Rock Show*, *Future Sounds*, *Life Hacks* and the *Drum and Bass show*.

Amongst the award-winners were Spark Sunderland, Insanity Radio (Royal Holloway, University of London) and Leeds Student Radio, who all received plaudits for the best event or outside broadcast.

The *Best Podcast* awards went to University Radio Bath, Spark Sunderland and Demon FM (De Montfort University, Leicester), while *Best Technical Achievement* went to University Radio York (which became the UK's first legal, independent, student radio station in 1968) and University Radio Nottingham, which commenced in 1979.

On November 12th, *Radiodays Europe* announced its Coronavirus radio awards winners. There were thirteen category winners, represented five continents.

GREG RAKOZY ON UNSPLASH

3

ALEXANDR BORMOTIN ON UNSPLASH

4

The categories included best parody, won for *Wash for Me* by Fly FM in Kuala Lumpur). The *Best Social Media Video* was *Social Distancing* by KIIS 106.5, Sydney in Australia. The Best Virtual Concert winner was *We Are One Africa Concert* from NRG Radio, Kenya. NDR in Hamburg's '*Coronavirus Update*' was the winner for best reporting. You can watch videos of all 13 awards online.

Covid Programme Successes

Independent podcasters have, of course, long been used to producing high-quality content under stressful circumstances. Finding a quiet space to record a programme in a shared house is problematic, and most people living with housemates or families do not have the luxury of a home office or spare room.

This is perhaps typified by teenager Connie, who lives with her parents in a flat above their travel agents in Ashton. As a result of Covid-19, the business was likely to go under. However, Connie reached out to their customers, and together they created an alternative approach to a traditional vacation: the *Adventures Armchair Adventures* podcast and activity pack, which takes you on a journey of the imagination.

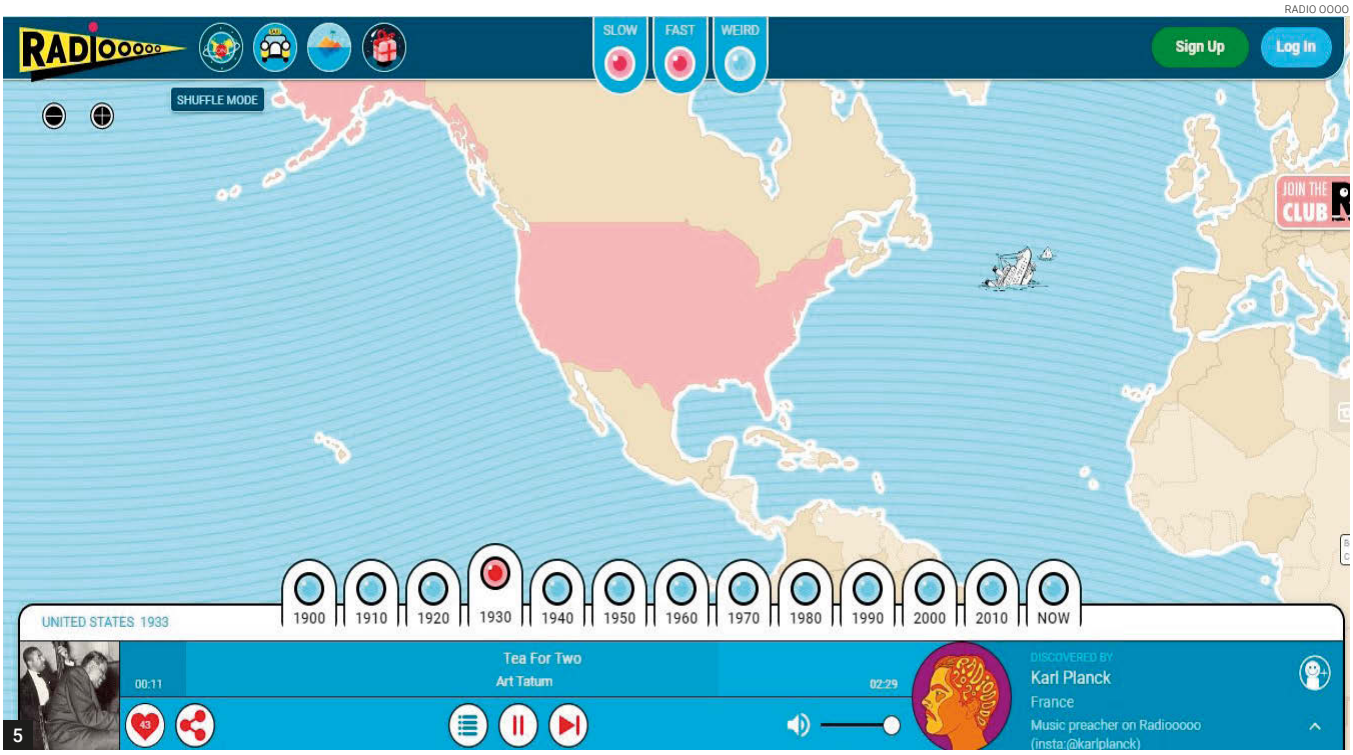
Manchester station ALL FM (ALL stands for the suburbs of Ardwick, Levenshulme and Longsight) was the Community Radio Station of the Year in 2019. It was one of many volunteer-led, community radio stations which were praised for adapting to the 'new normal': *The Meteor, Manchester's Independent Media* reported on December 5th how the station's 100 volunteer presenters fully changed their *modus operandi*, from live shows to pre-recording programmes at home.

Ed Connole, ALL FM's director and station manager stated, *"People used whatever tools they had to pre-record their own shows. Whether it be a laptop, a PC, a mobile phone, or a handheld recorder, people found a variety of ways to pre-record their show. The takeaway from the experience has been: 'We can find a way to make things work'."*, and over 70% of ALL FM shows were able to continue.

Graham Smith also pointed out two more radio stations that emerged to cover the coronavirus. Radio Corona Internationale (Fig. 1) was set up by Algerian broadcaster Abdallah Benadouda, from his home in Rhode Island, US. Reporters Without Borders explained that Abdallah was forced to leave Algeria in 2014 after a broadcast that annoyed senior government officials.

There are around 70 programmes so far, broadcast on *Facebook* and *SoundCloud* to thousands of listeners. If you do not understand French, then there is music to listen to as well.

The *MIT Technology Review* also produced a regular Corona podcast last spring, looking at how the coronavirus will change the world. Their mission statement



is, *"to bring about better-informed and more conscious decisions about technology through authoritative, influential, and trustworthy journalism."*

At the Radio Academy Festival in November, Ben Cooper, Group Director, Content and Music, Bauer Radio UK, led a session on the changes happening to radio during the pandemic.

He told *RadioToday* that as, a result of the pandemic, "*Radio is booming. The radio industry has seen huge increases in listening on connected devices as everyone battened down the hatches and tuned in. Here at Bauer, who have KISS, Magic and Absolute Radio and Greatest Hits Radio in their group of stations, saw an increase of over 40% in smart speaker listening across the portfolio during lockdown, with some individual stations scoring higher than that.*"

Many hobbies saw a marked increase during the lockdown. The areas of DXing and radio listening have probably been a beneficiary of this, as people took up or returned to the hobby, Radio listening per se also received a boost from the public, wanting to hear the latest pandemic news from several sources.

Conversely, radio has always been a good place to escape fear and to become blissfully lost in a play or concert. These changing listening habits have been reported on by many organisations, from the UK Radio Centre to global media organisation NielsenIQ.

References

- *Bird in the Sky*, The Radio Play Made Under the Duvet **https://tinyurl.com/y4jdrqte**
- Radio Academy Festival 2020 **https://tinyurl.com/y4mblr78y**
- Radio TechCon **www.radiotechcon.com**
- Südwestrundfunk youth radio station DASDING **www.dasding.de**
- Alexandria Perryman, audio engineer for the astronauts **https://tinyurl.com/y5arpnoz**
- Houston We Have a Podcast **www.nasa.gov/johnson/HWHAP**
- The Association of International Broadcasters **https://theaibs.tv**
- Armchair Adventures Podcast **https://tinyurl.com/y6rjqako**
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Radio OOOO

Laura Hallberg in California recently shared information on an amazing app, to the Radio GDR (German Democratic Republic) Facebook group. The *Radio OOOO* app appeared in 2018. Laura wrote, "*You select a country and a decade, and it plays music from that country at that time (the map even redraws according to the time). It's pretty cool to listen to music from the DDR* (Deutsche Demokratische Republik, East Germany – Ed.) *across various decades.*"

How about travelling to Angola in the 1970s, for the lilting sounds of *Kalumba*, by Gambuzinos? Or join me in 1960s' Norway for the catchy *Gi Meg en Cowboy Til Mann* by Wenche Myrre (aka Wencke Myhre).

Perhaps we will be journeying to Paraguay in 1943 to hear Jose Asuncion serenade you with *Villa Rica*.

This French-based app (Fig. 5) contains tracks discovered by users from all over the world and you can contribute by sending in your treasures, too!

The *Radio OOOO* app starts with recorded music from the year 1900, and it continues to the present day.

A Man of High Fidelity: Edwin Armstrong and Frequency Modulation

Scott Caldwell
Scottandrew.caldwell@yahoo.co.uk

Scott Caldwell reviews the life, achievements and tragic end of Edwin Howard Armstrong, the force behind commercialised FM Broadcast Radio.

For many, the name Edwin Howard Armstrong (1890 – 1954, Fig. 1) has become synonymous with the technology behind commercialised Frequency Modulation (FM) radio broadcasting. Armstrong was born on 18th December 1890, in New York City. He was regarded as a very impressionable child who was inspired by the book *Boy's Book of Inventions and Stories of Inventors"*.

He has also been described as a maverick who loved heights and music. When he built the 425-foot radio tower at the *Hudson River Palisades* (the steep cliffs which run along the west side of the lower Hudson River) he would climb it and swing from its 150-foot arms in a specially-rigged deck chair.

In a 1996 interview with The New York Times, Carl Kraus, station manager of WFDU, the only FM station to still broadcast from the tower, concluded that *"Armstrong is still there a presence you can feel"*.

His love of music manifested itself in his campaign to promote the widespread utilisation of FM radio in the broadcasting of clearer local radio, without the prolonged static interference that plagued the medium wave spectrum. By the age of 14, he had decided to become an inventor and desired to live the 'American Dream", gaining fame and fortune as the creator of technical wonders.

Armstrong believed quite strongly that the broadcasting industry should pay royalties for the exclusive use of the concepts and products he created. A similar approach was followed by Guglielmo Marconi (1874 – 1937) who successfully exploited the commercialisation of his wireless telegraphy services. This principle would dominate Armstrong's life and ultimately led to his untimely death in 1954, at the age of just 63 years old.


1

Background and Early Life

Armstrong was born into a comfortable, loving – and highly academic – household. His father, John Armstrong was the US Representative of Oxford University Press (OUP).

Armstrong was strongly inspired by the leading pioneers of wireless communication and he fully absorbed the work of Watt, Hertz, Tesla, Marconi, and Faraday. In 1912, he clashed with his father who refused to lend him $150 to file a patent that would safeguard his intellectual property rights on a feedback circuit.

Armstrong Senior stressed that his son should focus on his studies and file the patent after graduation from university. Nevertheless, the Westinghouse Electric & Manufacturing Company would soon recognise his remarkable talent and offered Edwin a figure of $530,000 over 10 years for the rights to the patents for regenerative and superheterodyne receivers.

In 1922, he achieved a further triumph, when he sold the rights to the super-regenerate circuit to RCA, for $200,000 and 60,000 shares in RCA stock. His shares portfolio soon increased to 80,000, due to payment for consulting services. This subsequently made him the largest individual shareholder in RCA.

Objections and Quarrels

Another prominent radio pioneer Lee DeForest (1873 – 1961) objected to Armstrong's claims and argued that the regeneration concept was originally *his* idea. He filed legal proceedings with the US Patent Office. Unfortunately, for DeForest, he lost the initial case hearing, yet he continued to appeal the ruling to the federal courts for almost two decades, in a bitter and protracted legal battle.

Remarkably, DeForest finally won his appeal after a hearing at the US Supreme Court. Many witnesses claimed that the judge failed to understand the very essence of the case, while the American scientific community was outraged at the ruling.

FM Modulation

The first attempt to modulate the *frequency* of a wireless signal (rather than its *amplitude*) was undertaken by

ALL PICTURES: PUBLIC DOMAIN

2

3

Fig. 1: The 'Father of FM Broadcasting': Edwin H. Armstrong (1890–1954). Fig. 2: RCA Director David Sarnoff (1891 – 1971). Fig. 3: *General Electric* advertisement from the 1940s, promoting the superior sound quality of FM.

Danish engineer Vladimir Poulson (1869 – 1942) in 1903, with his "*arc generator*" wireless transmitter. However, it proved to be ultimately unsuccessful. In 1922, John Renshaw Carson (1886 – 1940), a scientist at the American Telephone and Telegraph Company (AT&T), applied mathematical theory, and he concluded that FM would inherently distort the signal without providing any compensating advantages.

Despite the disappointing results, a few researchers continued to investigate the potential of FM to reduce the static interference that plagued medium wave broadcasting. The researchers were predominantly engineers who worked for the leading manufacturers of radio receivers of the era, most noticeably Westinghouse who had registered approximately 28 patent applications by 1928.

RCA also investigated the potential of FM in relation to its telegraph circuits by 1928. Unfortunately, the conclusions that were drawn by both Westinghouse and RCA only seemed to confirm Carson's disappointing findings that FM broadcasting was counterproductive. The subject of FM broadcasting thus became ridiculed by the radio industry, with the potential of delivering little payback for their extensive developmental efforts.

Pioneering Persistence

However, one man was determined to solve the technological curiosity of FM broadcasting – the well-respected engineer and scientist Edwin Armstrong. He decided to focus his research efforts on the principle of frequency modulation. He soon discovered the same problem that had plagued previous researchers. Armstrong nearly gave up on FM broadcasting after becoming frustrated when trying to utilise FM in the narrow spectrum channels (10 kHz).

However, Armstrong was a true polymath underpinned by a fierce determination to overcome research setbacks. On pure intuition, he pondered the concept of combining FM transmissions with a wider transmission channel. The initial experiments at his Columbia University laboratory indicated that Armstrong had made a highly significant breakthrough.

These successful results enabled Armstrong to expand his research, and soon his equipment filled more than one large room in the basement of Columbia's Philosophy Hall (home to the university's physics department). Armstrong put his heart and soul into his research, working full-time for six years, perfecting the functionality of his wideband FM system.

His research logbooks make for remarkable reading, chronicling more than 100,000 experiments between the years 1928 to 1933. The validity and reliability of his experimental results allowed him to register his first patent application in July 1930. Patents for the last of the four basic systems were granted on the 26th December 1933.

With his intellectual property rights safely filed, he first approached the formidable manager of RCA, David Sarnoff (1891 – 1971; Fig. 2; *RadioUser*, May 2019: 23-25) to whom he demonstrated his latest FM innovation. An interesting personal side note here is that Armstrong had married Sarnoff's secretary; this facilitated considerably better access to Sarnoff's limited time.

However, the professional relationship between Armstrong and Sarnoff would rapidly deteriorate: RCA planned to utilise the FM spectrum to carry their television broadcasts, and the company refused to pay Armstrong the royalties he demanded for its exclusive use.

Networked FM Broadcasting in the US, 1934 – 1940

In 1938 - 39, Armstrong embarked on a 'radio crusade' throughout the nation, speaking with inexhaustible passion and energy. He funded his campaign from his finances and presented his concept of FM radio to various influential clubs and technical societies. By the autumn of 1939, a total of 150 applications had been filed with the Federal Communication Commission (FCC), requesting permits to operate FM stations (Table 1).

Later on, *FM Broadcasting Inc. (FMBI)* was formed as a trade association dedicated to promoting FM's commercial appeal. The FMBI issued a *'Broadcasting's Better Mousetrap'* leaflet, describing FM superior sound quality (Fig. 3). More than 30,000 copies were distributed nationwide: *"First of all, the programmes are clearer than the proverbial bell. Each sound, each note of music, comes over the air with the identical clarity it would have if produced right in the same room with you. The announcer whispers, and you start at his nearness. A match strike: you can hear its crackle, then the intake of breath as a cigarette is lit. Water is poured from one class to another with a clear, liquid slosh. Try these things in front of the microphone of a regular amplitude-modulated station and you will find your listeners tuning away from an ear-splitting galaxy of misshapen sounds. But FM is so lifelike you can practically reach out and shake hands with the announcer".*

Education and Radio

The decision to allow educational radio stations to broadcast on FM for free was a clever move by Armstrong who built up a strong contingent of pro-FM lobbyists. The periodical *'Education for Victory'* also became a loyal and outspoken supporter for nationwide FM broadcasting. The editors behind the publication conducted an extensive public relations campaign that cited Armstrong as the perfect role model for the American youth. They also published a series of articles that promoted FM broadcasting: *FM for Education 1944, Programme Planning for FM School Stations 1944, The Need for Educational FM Broadcasting for Additional Channels 1944, Looking Forward to FM Broadcasting 1944,* and *Education Opportunities in Radio 1944.* The June 1944 edition (*Programme Planning for School Station*) detailed the experiences of the *Cleveland School District* in the development and operation of their radio station, WBOE: *"From morning to afternoon, WBOE presents programmes tailored to the specific needs of elementary and secondary schools. Aside from these programmes then, what are some related activities in which a school station can be of service? Consider a few emergency issues. When there was talk of air raids, the public, parochial, and suburban schools of Greater Cleveland established continuous listening procedures whereby WBOE could alert the area in a few seconds. When the teachers were engaged in rationing, daily bulletins were broadcast to the rationing centres answering questions which had arisen. The school station made many friends that day"* (*Education for Victory*, June 1944, p.6).

9th June 1934	W2XF	Armstrong NBC Labs	New York City
6th November 1935	W2AG	C.R. Runyon	Yorkers
10th April 1938	W2XMN	E.H. Armstrong	Alpine, New Jersey
13th May 1939	W1XPW	F.M. Doolittle	Meriden
May 1939	W1XOK	Yankee Network	Boston
June 1939	W1XOJ	Yankee Network	Paxton
29th August 1939	W1XSW	Westinghouse	Springfield, MA
September 1939	W3XO	Jansky & Bailey	Washington DC
1st November 1939	W8XVB	Stromberg – Carlson	Rochester, NY
December 1939	W1XER	Yankee Network	Rochester, NY
11th January 1940	W2XWG	NBC Network	New York City
15th January 1940	W9XAO	Journal Co	Milwaukee
1st February 1940	W9XAD	WHEC Inc	Rochester, NY
2nd February 1940	W9XEN	Zenith Radio	Chicago
1st March 1940	W2XOR	Bamberger Broadcasting	Newark, NJ
15th March 1940	W9XYH	WHEC Inc	Superior, NJ
March 1940	W1XSO	Travelers Insurance	Hartford, CT
29th March 1940	W8XVH	WBNS Inc	Columbus, OH
17th June 1940	W1XTG	Telegram Publishing	Worcester, MA

Table 1: Indomitable: A Timeline of Armstrong's Campaign for FM Broadcasting.

Licensing Issues

In the autumn of 1940, a formal offer was made to Armstrong's attorneys by Sarnoff himself. He proposed that RCA should be given a non-exclusive licence under the FM patents for a total cash payment of US$1 million, with no payment of royalties. This offer was rejected out of hand, although Armstrong was under increasing financial pressure that necessitated in him selling off his shares in RCA.

By 1945, opinions within the radio broadcasting sector had begun to slowly change regarding the future of FM broadcasting. Paul W. Kesten, the Executive Vice President of Columbia Broadcasting Systems wrote:

"I believe that FM is not merely one aspect of the future of audio broadcasting – but that it contains in itself almost the whole future audio broadcasting. Most of us at CBS have believed, from the very early days of FM that, except in certain rural areas, FM was technically destined to replace AM transmissions, as surely and inevitably as the tungsten lamp was destined to replace the old carbon filament".

J.E. Brown, Assistant Vice-President, Zenith Radio Corporation, concurred in his testimony before a Congressional committee in 1948: *"An accurate analysis of the status of FM Broadcasting toward the end of the war would be that it had been tried and proven, was found satisfactory and was destined to become the great new post-war development in radio".*

The growing enthusiasm for FM broadcasting continued even after the FCC shifted the FM frequency spectrum from 42-50kHz to 88-108kHz in 1945. This initially left owners of FM receivers with a technology that would soon become obsolete, and it also required FM stations to modify their existing transmitters.

A Tragic End

In his lonely apartment, Armstrong became a depressed, bitter and broken figure. He wrote a final letter to his wife, Marion, who had gone off to Connecticut in protest after he had refused to retire and relax. Marion was becoming increasingly concerned about his violent outbursts and agitated mental state.

The constant legal battles had finally broken his physical and mental strength. His basic FM patent was running out and his current legal battles showed every sign of outlasting the protracted legal action that defined the DeForest case.

On 31st January 1954, Armstrong had lost the will to continue the fight against the radio industry powerhouses (RCA and NBC). He jumped from a 13th-floor window of River House and died instantly. Finally, he had peace from the pressures of his work (Pinkerton, 2019: 78-80).

Conclusion

In the aftermath of Armstrong's heart-breaking death, Marion continued his legal fight. Thanks, largely to her dogged determination, all 21 legal disputes that were based on copyright infringement on his FM patents were decided in his estate's favour. In many respects, it was a *'David and Goliath'* legal battle. It pitted Armstrong's estate against the powerful organisations of RCA and NBC. Armstrong's dependency on legal recognition drained his mental and physical energy, while systematically devouring his amassed fortune.

Armstrong was posthumously elected by the International Telecommunications Union (ITU) in Geneva to the roster of 'electrical greats', standing beside such greats as Alexander Graham Bell or Guglielmo Marconi.

The *Armstrong Memorial Research Foundation* was established by Marion. Its objective was to, "*celebrate and memorialise the genius of Edwin Howard Armstrong"*. This was realised by means of lectures, academic awards to aspiring students, and financial assistance to radio stations that advocated the utilisation of FM broadcasting. The intellectual property and image rights were also successfully managed, resulting in museum exhibitions, publications of books, and media rights to produce a film that chronicled Armstrong's fascinating life. Marion donated much of Armstrong's research notes and equipment to the foundation, building up its archive into a leading research institution. She also financially supported the research work of the Smithsonian Institution and the Columbia University, where Armstrong had been an alumnus, professor, and major benefactor. Marion assisted in the publication of Lessing's book that chronicled the life of Armstrong by proofreading and correcting the chapters. She also collaborated with Carl Dreher, a long associate of Armstrong, who published the article: *"E.H. Armstrong – The Hero as Inventor".*

Further Reading

- Bathgate, G. (2020) *Radio Broadcasting. Pen & Sword History: Croydon (UK).*
- Lessing, L. (1954) *'The Late Edwin H. Armstrong', Scientific American,* 190(4), pp. 64-69.
- Lessing, L. (1984) *'Looking Back: Man of High Fidelity: Edwin Howard Armstrong',* IEEE October, pp. 41.
- Pinkerton, A. (2019) *Radio* (Reaktion Books/ Science Museum).
- Sterling, C.H. and Keith, M.C. (2008) *Sounds of Change: A History of FM Broadcasting in America* (Univ. of North Carolina).

Radio News

AMPLIFYING THE MENTAL HEALTH CONVERSATION IN 2021: Radio X has teamed up with *Campaign Against Living Miserably (CALM)* to create a series of podcasts offering mental health support. Radio X's Mental Health Tool Kit with CALM – exploring grief and bereavement, anxiety, depression, financial stress and ways to seek help – launched on Monday 14th December 2020 on Global Player and other podcast locations. The podcasts have been voiced by well-known artists, comedians and broadcasters.

Each host will explore an area of mental health, guiding listeners through the advice, support and expertise offered by CALM, with some reflecting on their experiences.

Comedian and *Love Island* star Iain Stirling will speak about anxiety, while the host of *The Mash Report*, comedian Nish Kumar, will talk to listeners about financial stress. Biffy Clyro's Simon Neil will speak about grief and bereavement, and former elite Special Forces soldier and *SAS: Who Dares Wins* instructor Jason Fox will host a podcast on the topic of depression.

(SOURCE: Radio Today)

https://tinyurl.com/ybe7f423

LOVE SPORT RADIO: *Love Sport Radio* has ceased transmission on the national Sound Digital Ltd multiplex marking the end of the road for the service.

The station told listeners it was taking a break back in April, due to Coronavirus (Covid-19), and it has been airing mostly non-stop music ever since. *Love Sport*, founded by Kelvin MacKenzie, joined SDL a year ago, taking over the slot from Panjab Radio; but, as of 10 pm on New Year's Eve 2020, it is no more.

Kelvin told *RadioToday*: *"Covid killed the radio star. Commercial revenues collapsed in March. The radio business, especially small radio, is taking a terrible hammering."* Glyn Jones, who manages Arqiva's DAB multiplexes, told *RadioToday*: *"2020 was a very tough year for commercial radio. Arqiva has worked hard to support the sector and keep everyone on air. This has included offering financial support to stations – especially small stations and start-ups. It is always very sad when someone switches off and we're sorry to see Love Sport go."* Love Sport's most recent AM frequency in London, 1584KHz, now carries programmes by Asian FX radio

(SOURCE: *Radio Today UK*)

https://tinyurl.com/ybp2su6u
https://www.lovesportradio.com

Radio News

THE RADIO ACADEMY

FIRST RADIO AND AUDIO STUDY: The *Radio Academy* has launched *The Radio and Audio Study* – the first-ever in-depth survey targeting everyone working in, or aspiring to be part of, the UK's radio and audio industry. The findings, which will be revealed in November at this year's *Virtual Radio Festival*, aim to show the current makeup of the industry, highlight opportunities for the sector and offer insight on how we might create a more diverse, vibrant and successful future. Radio Academy CEO John Dash commented: *"The Radio and Audio Study will hold a mirror up to our sector allowing us to see who's working in our industry and what they're looking for from* The Radio Academy, *their careers and their employees. The idea of the study came out of our Diversity and Inclusion work, but I know it will have far-reaching benefits in how the Academy can support and serve our members."* The *Radio Academy* is encouraging anyone working in, or aspiring to be part of, the UK radio and audio industry to complete the short survey as well as share it with colleagues and friends. The deadline to complete the survey was on Friday, October 23rd at 6 pm. When it had passed, John added: *"I'd like to thank Deanna Hallet and Matt Deegan for their help in delivering the research project which will hopefully become a valuable reference point in helping shape future activities."*
(SOURCE: *Radio Academy, Radio Today*)

OLD BBC RADIO BROADCASTING EQUIPMENT AND MEMORIES: On these pages, you can find are pictures of old BBC radio equipment and memories from the people who built, maintained and used it. The website does not aim at building a comprehensive history but wants to provide some 'snapshots' of times and places. Compiled and edited by Roger Beckwith.
(SOURCE: Bob Houlston G4PVB)
www.orbem.co.uk

RSGB EXAM NEWS: The RSGB has just launched a series of videos to help people who have taken their *Foundation Exam* via remote invigilation whilst being unable to take the practical assessments. The 30-minute video highlights six practical skills and each segment stands alone rather than being part of a single 'story' through the video. As well as this whole video, the Society has published the different segments as separate short videos to make it easier to go back to just one or two parts again. The RSGB is grateful to the clubs and individual radio amateurs who have created other available online training resources. With the launch of these videos, the Society is now pleased to add to the resources that new licensees have available to them. The RSGB would like to thank everyone involved in making these videos, including Bob and Nick from *The TX Factor*. You can watch the videos on the RSGB's website:
(SOURCE: Heather Parsons, Communications Manager, RSGB; Tel: 07710 395 012)
heather.parsons@rsgb.org.uk
www.rsgb.org/foundation-practicals

European Private Shortwave Stations

Stand: January 1st 2021

Only legal stations are included. Most stations use 100 to 3,000W of power.
D = Germany, DNK = Denmark, FIN = Finland, NL = Netherlands, NOR = Norway, Irr. = irregular, F.pl.: future plan, min. = minutes, Mo = Monday, Tu = Tuesday, We = Wednesday, Th = Thursday, Fr = Friday, Sa = Saturday, Su = Sunday.

kHz	Country	Name	Transmitter site	Schedule (UTC)
3920	NL	Radio Piepzender	Zwolle	Mainly weekends
3955	D	Radio Channel 292	Rohrbach Waal	24/7
3975	D	AM Shortwave Radio	Winsen	Daily 0700-2300
3985	D	Shortwaveservice	Kall-Krekel	Daily 1500-2300
3995	D	HCJB	Weenermoor	24/7
5810	NL	Mike Radio	Heerde	Irr.
5895	NOR	The C / Radio Northern Star	Bergen	Daily 0429-1358 / 1359-2310
5920	D	HCJB	Weenermoor	Daily 0600-1700
5930	DNK	World Music Radio	Bramming	Daily 0700-1745
5970	DNK	Radio208	Hvidovre	Daily 0700-1600 (from Jan 8th2021)
5980	DNK	Radio OZ-Viola	Hillerød	We 2200-2300, Sa-Su 1200-1400
5980	FIN	Scandinavien Weekend Radio	Virrat	1stSaturday of the month (not January)
6005	D	Shortwaveservice	Kall-Krekel	Daily 0900-1700
6005	NL	Radio Delta International	Elburg	Irr. within 2100-0200 UTC
6020	NL	Radio Delta International	Elburg	Irr. within 0700-1600 UTC
6070	D	Radio Channel 292	Rohrbach Waal	Mo-Fr 0600-2200, Sa-Su 0500-0300
6085	D	Shortwaveservice	Kall-Krekel	Daily 0800-1700 (Radio MiAmigo)
6115	D	Radio SE-TA 2	Hartenstein	Irr. Sa-Su 1000-1200
6140	NL	Radio Onda, Belgium	Borculo, NL	Weekends only
6150	D	Europa 24	Datteln	Daily 0700-1600
6160	D	AM Shortwave Radio	Winsen	Daily 0800-1600
6170	FIN	Scandinavian Weekend Radio	Virrat	1stSaturday of the month (not January)
7310	D	Shortwaveservice	Kall-Krekel	Inactive (1000-1400)
7365	D	HCJB	Weenermoor	Daily 0900-1400
9670	D	Radio Channel 292	Rohrbach Waal	24/7
11690	FIN	Scandinavian Weekend Radio	Virrat	1stSaturday of the month (not January)
11720	FIN	Scandinavian Weekend Radio	Virrat	1stSaturday of the month (not January)
15790	DNK	World Music Radio	Randers	Sa-Su 0700-2000
15880	NL	Radio Piepzender	Zwolle	F.pl.

This list is compiled by Stig Hartvig Nielsen (**shn@wmr.dk**) each first day of the month – and is based on details supplied by the various radio stations, the stations websites and HFCC registrations. The list is not copyrighted and may be published everywhere. Next list will be published on February 1st 2021.

DAVID SMITH

1

Helicopter Routes, Low-Level Operations, & Atlantic Separation

David Smith
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David Smith reports on new helicopter routes, improved ground tracking, and space-based ADS-B. He also presents Part One of an overview of ATC operations at London Gatwick Airport.

The management of low-level aircraft within the London and London City Control Zones (CTR) has evolved over more than 40 years. Whilst there have been changes, as a result of both ATC and operator feedback, the fundamental principles of use have remained constant. Moreover, the defined London Helicopter Routes have been in existence for decades and have not undergone any significant changes since they were introduced, although the density and height of the urban environment have evolved significantly since their introduction.

Following several reviews, key areas where changes were required have now been identified. The overall objective is to ensure that the ATC, operators and regulatory requirements can continue to be maintained and wherever possible simplified in their application, as well as maintaining or improving the existing high levels of safety within the airspace.

The existing design of the Helicopter Routes currently allows pilots to comply with the *Rules of the Air;* however, there has been an opportunity to further enhance the operational environment through a re-evaluation of the route profiles. This pertains to the raising of maximum altitudes, the general conditions of availability and the requirements associated with 'holding' on these routes.

Visual Reference Points (VRPs) have, of course, been specified for the London and London City Control Zones. Nevertheless, both ATC and pilots routinely use prominent ground features as 'unofficial' VRPs. The latter include, for example, the London Eye and Wembley Stadium. Following consultation with operators, sixteen new VRPs have now been established. Their use intends to assist with existing traffic flows and not routinely introduce new areas to be overflown.

When an ATC clearance is issued to a pilot wishing to operate on London Helicopter Routes the phrase 'Standard Operating Altitude' is used. This means a pilot may operate up to the maximum published altitude for the route. Pilots may fly at altitudes below the maximum published altitude for the route, but they are encouraged to operate at as high an altitude as possible to reduce the impact of noise.

Heathrow Surveillance

A significant project to fully update the ground-based surveillance system at Heathrow Airport has reached a major milestone, thanks to NATS air traffic engineers. The project has seen the NATS team, working with Heathrow, to update 31 multilateration ground stations, in addition to installing 21 new ones, and masts, across the airport. This equipment is vital to monitoring the safe movement of aircraft and vehicles.

All the new ground stations have now been brought online; this was work that involved the team reaching inaccessible locations all over the airfield, while often working through the night, to not disrupt normal operations. The system uses multilateration and ADS-B technologies to track aircraft and suitably equipped airside vehicles. The busy and complex layout of an airport is often a challenging environment for conventional surveillance systems. Multilateration uses multiple ground stations to determine the position of aircraft, both on the ground and on approach, as well as providing altitude, identification and downlinked data. This information forms a vital part of NATS' 'Intelligent-Approach' system for separating arriving aircraft.

Heathrow was the first airport in the world to adopt multilateration in 2000. This

Fig. 1: Boeing 757 of TUI Airways at Manchester.

latest upgrade will help ensure it continues to provide high quality and accurate data for both the control tower and Heathrow operations teams, which is vital for the safe and efficient running of the airport.

Iain Harris, NATS Director of Service Operations, said: *"We knew that night-time access to the 52 sites would be required to minimise the operational impact. The teams have been working on sites including terminal roofs, air bridges, lighting poles, as well as one site on a local hotel. It's been a challenge, especially with added Covid restrictions, but it means we've helped deliver increased coverage and more accurate performance to the tower and airport, preparing it for many years more service and future use."*

As well as installing new ground units, the team also moved communications links over to fibre, updated software and replaced remote units of older generations.

The final work to complete the software upgrade will be undertaken over the next few months.

Atlantic Separation Standards

The transformation of North Atlantic operations took another step forward in November with the permanent adoption of reduced aircraft separation standards. Since the introduction of the Aireon Space-Based ADS-B service in March 2019, NATS, NAV CANADA and NAV Portugal have been trialling the use of reduced separations standards – known as ASEPS or 'Advanced Surveillance-Enhanced Procedural Separation Standards' – for aircraft flying through Oceanic airspace.

Having real-time surveillance over the Ocean for the first time has made it possible for air traffic controllers to safely reduce the longitudinal spacing between aircraft, from 40 nautical miles down to just 14 nautical miles, allowing more aircraft to share the fastest, most environmentally friendly routes. The success of the trial means the separation standards have now been permanently adopted, as well as published in worldwide ICAO documentation.

In addition to allowing more aircraft to take advantage of the most efficient routes and levels available, the introduction of real-time surveillance has also delivered benefits to safety, with controllers now able to intervene far quicker if an aircraft leaves its cleared trajectory.

https://tinyurl.com/y2dm9we8

This month's picture (Fig. 1) shows a Boeing 757 of TUI Airways at Manchester.

ATC Profiles 28 Part One: London Gatwick Airport

ICAO Code: EGKK IATA Code: LGW

Frequencies	**(MHz)**	**Hours of Operation**
Gatwick Director	118.950	When instructed by
	126.825	H24
	129.025	When instructed by ATC
Gatwick Tower	124.230	H24
	119.025	When instructed by ATC
Gatwick Ground	121.805	0530-2300
Gatwick Delivery	121.955	0630-2100, or as directed.
ATIS		
Gatwick Information	136.525	
Gatwick Fire (non-ATC)	121.600	Fire vehicles aircraft on the ground
Navaids	**ILS CAT III on 08R and 26L**	
Runways	08 Left	2565 x 45m
	26 Right	2565 x 45m
	08 Right	3316 x 45m
	26 Left	3316 x 45m
Holds	See below	

NOTES (A-Z)

Airbus A380
Taxiway routes available to the A380 are shown on the aerodrome chart and are marked in yellow. There is a positive but substandard obstacle clearance (minimum of 47.5m) on Taxiway Juliet A380 routing. Pilots are to ensure that the Cockpit over Centre-line (COCL) technique is used at all times when manoeuvring at Gatwick.

Airport-Collaborative Decision Making (A-CDM)
Definitions of Commonly Used A-CDM Terms: Calculated Take-Off Time (CTOT): Assigned by Eurocontrol's NMOC when flow restrictions are in place. Aircraft must depart within -5 to +10 minutes of its CTOT (as an existing requirement). Target Off-Blocks Time (TOBT): The time an aircraft is expected – and agreed by Ground Handling Agent and flight deck – to be ready to leave the stand (in the case of normal operations), or ready for on stand de-icing to commence (where appropriate, in the case of winter operations). This must be updated to an accuracy of +/- 5 minutes by GHA. Accurate and stable TOBTs enhance operations on the ground as they provide all airport partners with a clear picture of the intentions of aircraft on the ground. Target Start Approval Time (TSAT): The time provided by ATC that an aircraft can expect to receive start approval. TSAT will be displayed on Stand entry Guidance System (SEGS). Aircraft on stands with no active SEGS will have TSAT confirmed by Gatwick Delivery on initial call-up. Alternatively, TSAT can be advised by the Company Dispatcher. TSAT should reduce queuing times at the runway hold while maintaining a high runway utilisation. Calculated automatically by the Departure Sequencer by considering TOBT, CTOT, wake vortex, SID routing, Variable Taxi Time (VTT), demand, and any capacity constraints, for instance, Low-Visibility Procedures.

Target Take-Off Time (TTOT): The time that an aircraft is expected to take off. TTOT is calculated by adding a VTT to the TSAT. TTOT is updated in line with any updates to the TSAT. Time is a Target: the requirement for an aircraft to be airborne within a time window only applies to flights with a CTOT. The Flight Deck must comply with the following A-CDM procedure: "You should ensure that your flight is ready to push at TOBT +/- 5 minutes: ground activities completed, doors closed, push-back tug connected, cockpit ready for start-up. Maintain regular communication with the GHA. They are responsible for updating your TOBT. If you identify a delay to TOBT +5 or believe you will be ready to depart earlier than TOBT -5, notify the GHA right away. At TOBT +/- 5 mins: You must report to Gatwick Delivery: *"[Call-sign] [stand] [QNH] ready"*. You will either receive Start Approval or Gatwick Delivery will respond: *"[Call-sign], roger"*. You can observe your TSAT on SEGS and expect a call back from Delivery within TSAT +/- 5 mins. Aircraft on stands with no active SEGS will have TSAT confirmed on initial call-up. At TSAT +/- 5 mins Gatwick Delivery will call you: *"[Call-sign] information [ATIS identifier], [QNH], hold position, contact ground frequency 121.805MHz"*. You reply: *"[Call-sign] information [ATIS identifier], [QNH], Hold position, contact ground frequency 121.805MHz"*. Switch to ground frequency and report: *"[Call-sign] [stand number]"*. Ground call you: *"[Call-sign] [stand] push-back and start approved"*. You reply: *"[Call-sign] push-back and start approved [push-back instruction]"*. Non-ACDM-compliant flight deck should then contact their handling agent.

Aprons
Before the Aircraft Commander calls for pushback, they must ensure that the tug driver is in the tug, ready to push. If ATC issue a non-standard or conditional pushback clearance, ATC must be advised if the Aircraft Commander is not in two-way headset communication with the tug crew. The tug driver must listen to the exchange between the aircraft crew and ATC so that the tug crew have a full understanding of the detail of the ATC approval. If the tug driver has not heard the pushback instruction they must not push the aircraft. Request and clearance will be issued between the flight crew and ATC only. On receipt of pushback instruction, the flight crew shall report the instruction to the ground crew. Any clarification required from the tug driver shall, in the first instance, be directed to the flight crew. If further clarity is required then the tug driver should contact ATC.

CAT II/III Operations
Runways 08R and 26L, subject to the serviceability of the required facilities, are suitable for Category II and III operations. During Category II and III operations, Low-Visibility Procedures will be applied. Pilots will be informed when these procedures are in operation by ATIS broadcast or by RT. Arriving Aircraft: All appropriate runway exits will be illuminated, and pilots should select the first convenient exit. Ground Movement Radar (GMR) is normally available to monitor pilot 'runway vacated' reports. When GMR is not available to ATC, runway (LSA) vacation will be confirmed by receipt of a pilot report that the tail of the aircraft has passed the last of the alternate amber and green centre-line lights. These lights denote the extent of the ILS Localizer Sensitive Area. When Low-Visibility Procedures are in force, a much-reduced landing rate can be expected due to the requirement for increased spacing between arriving aircraft. In addition to the prevailing weather conditions, such factors as equipment serviceability may also affect actual landing rates. For information and planning purposes, the approximate landing rates to be expected are as follows:

Expected hourly Landing Rate and Runway Visual Range:
Greater than 1,000m - 24
Between 1,000m and 600m - 20
Between 550m and 350m - 15
Less than 300m - 12 or less.

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CP-18E cigar lighter cable **£24.95**
CS-R6 cloning software for IC-R6 ..... **£34.99**
SP-27 clear acoustic earpiece **£24.95**
BC-223 rapid charger for IC-R30 ..... **£59.95**
BP-287 hi capacity 3280 mAh replacement battery for IC-R30 ..... **£74.95**
BP-293 dry cell case (3x AA) for IC-R30 ..... **£34.99**
CS-R30 programming software for IC-R30 ..... **£59.95**
LC-189 soft case for IC-R30 ..... **£24.95**
CS-R8600 software for IC-R8600 ..... **£69.95**
RS-R8600 remote control software for IC-R8600 ..... **£99.95**
RC-28 remote control system for IC-R8600 ..... **£279.95**
SP-38 desk top speaker for IC-R8600 ..... **£149.95**
SP-39AD external speaker with DC power supply for IC-R8600 ..... **£199.99**
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bhi Noise Cancellation Products

bhi design & manufacture a range of DSP noise cancelling products that remove unwanted background noise & interference from noisy voice & radio communication channels to leave clear speech. Aimed at a number of different radio related & voice communication markets, our products incorporate unique Digital Signal Processing technology to enable clear communications from within noisy environments.

NES10-2 MK4 Noise Eliminating Speaker replaces the MK3 version and removes unwanted background noise, hiss, hash, QRM, QRN, computer hash, plasma TV interference, white noise etc from speech, so that you can hear more clearly and listen stress free. Works across all radio bands and is also suitable for shortwave listening and for use in radio base stations. **£119.95**

Uniden

Uniden is the best known manufacturer of scanner radios in the world. Under its renowned "Bearcat" brand name, Uniden scanners are at the cutting edge of design and technology. Their high-end scanner radios, while complex, are used by radio hobbyists, media, businesses and at all levels of government and there lower end versions are beautifully designed and easy-to-use

PRE-LOADED UBC-125 DELUXE AIR BAND KIT WITH ACCESSORIES JUST £219.95

Handheld

EZI-33XLT 78-174/406-512 MHz 180 channel analogue scanner **£64.99**
UBC-75XLT 25-512 MHz 300 channel analogue scanner **£99.95**
UBC-125XLT (best seller) 25-960 MHz 500 channel analogue scanner **£139.95**
UBCD-3600XLT (NXDN Version) 25-1300 MHz Digital & Analogue scanner **£479.99**
SDS-100 Advanced 25-1300 MHz Digital & Analogue scanner **£589.95**

Mobile/Base

UCB-355CLT 25-960 MHz 300 channel analogue scanner **£89.99**
UBC-370CLT 25-960 MHz 500 channel analogue scanner **£119.95**
BCT-15X GPS enabled 25-1300 MHz 9000 channel analogue scanner **£249.95**
SDS-200E Activated DMR+NXDN+ProVoice 25-1300 MHz Digital & Analogue **£749.99**

Accessories

UBCD3600XLT soft leather case **£29.95**
UBC-125/75 soft leather case **£24.95**
ARC-536 pro software for UBCD-3600XLT **£49.99**
ARC-536 basic software for UBCD-3600XLT **£29.99**
ARC-370 software for UBC-370CLT **£24.95**

DIAMOND ANTENNA

Based in Japan, Diamond Antenna manufactures a wide range of antennas and accessories for both hobby radio and commercial use. They are well known products that meet the highest standards in quality.

Scanner Antennas

D777 is a VHF/UHF civilian and Military air band receiving antenna. It has a gain of 3.4dB on VHF (120MHz) and 5.5 dB UHF (300MHz) with a length of 1.7m and SO239 socket for easy connection **£64.99**

D-190 is a high performance wideband discone antenna covering 100-1500 MHz including 10m RG58 terminated in PL259 ..... **£99.95**

D-130M is a Discone antenna with wide frequency coverage on receive 25 to 1300MHz and covers 6m (20W) and 2m (200W) when used with a transmitter. This model is supplied with 15m RG58A/U and 2 x PL259 plugs **£129.95**

WHISTLER

The Whistlers Scanners are USA designed and built to last – The TRX-1 & TRX-2 are our best-selling digital versions with sales 10-1 against any other brand. We have worked with Whistler to customise a UK band plan for these scanners! This ensures the radios cover UK bands in the correct steps and the correct mode. When a user does a service scan it will search in the correct steps for the selected band ensuring maximum received stations.

Handheld

WS1010 25-512MHz 200 channel analogue scanner **£89.95**
WS1040 25-1300 MHz storage for 1800 frequencies analogue scanner **£299.95**
TRX-1E 25-1300 MHz best-selling Digital & Analogue scanner **£419.95**

Mobile/Base

WS1025 29-512 MHz 200 channel analogue scanner **£99.95**
WS1065 25-1300 MHz storage for 1800 frequencies analogue scanner **£279.95**
TRX-2E 25-1300 MHz best-selling Digital & Analogue scanner **£499.95**

Accessories

TRX-1 leather case **£29.99**
MRW-TRX3 Triple hand held replacement antenna pack to increase performance **£39.95**
TRX-1 or TRX-2 SD Card – preprogramed with Airband, Marine, 446, FM/DMR/NXDN/25 Repeaters + FM/DMR simplex **£19.99**

LEATHER CASE for TRX-1 £29.95

FlightAware

Live Flight Tracking

FlightAware has revolutionized the world of USB SDR ADS-B Receivers with the FlightAware Pro Stick and Pro Stick Plus, high-performance USB R820T2 software defined radios (SDR) with a built-in RF amp for maximum ADS-B/MLAT performance. The first of its kind, FlightAware's Pro Stick is compatible with PiAware or any other device that supports USB RTLSDR receivers, and is less expensive than any other RTLSDR USB receiver in the world. The Pro Stick Plus adds a built-in 1090 MHz bandpass filter for increased performance and range of reception in areas with moderate RF noise as is typically experienced in most urban areas.

Flightaware Prostick Plus **£29.99**
Flightaware Prostick **£24.95**
FlightAware ADSB 1090MHz Band-pass SMA Filter **£17.99**

AIRSPY

Redefining The Radio Experience.

Airspy is a line of super popular Software-Defined Radio (SDR) receivers developed to achieve high performance at an affordable price using innovative combinations of DSP and RF techniques. The goal is to satisfy the most demanding telecommunications professionals and radio enthusiasts while being a serious alternative to both cost sensitive and higher end receivers. Airspy Radios feature world class reception quality and ease of use thanks to the tight integration with the de facto standard free SDR# software for signal acquisition, analysis and demodulation.

HF+ Discovery 0.5kHz – 31MHz VHF 60-260MHz SDR receiver **£199.95**
R2 VHF/UHF 24-1800MHz SDR receiver **£209.95**
MINI VHF/UHF 24-1700MHz SDR dongle..... **£119.95**
Spyverter R2 extend your AIRSPY coverage **£59.99**
NEW YouLOOP indoor HF Antenna 0.5-52MHz **£29.99**

TECSUN

Tecsun is a world famous manufacturer of AM,FM and shortwave radios. They offer a great range of portable options from just £44.95

Portable

PL-360 This pocket world band radio, with AM & FM reception, keeps you in with the action from Long Wave , Shortwave(2.3-21.95MHz), FM (87-108MHz)..... **£49.99**
PL-606 is a DSP-based portable LW/MW/FM/SW (2.3-21.95MHz) shortwave radio..... **44.95**
PL-310ET is a portable multi band radio covering FM 76-108 AM 522-1620 kHz SW 2300-21950 kHz LW 153-513 kHz..... **£49.99**
PL-680 is a fully featured world band portable radio with SSB covering FM 87–108 MHz MW 522-1620 kHz SW 1711-29999kHz LW 100-519 kHz AIR 118-137 MHz..... **£149.95**
PL-880 is the flagship portable radio fitted with analogue Hi-IF circuit, multi conversion , & DSP decoding technology, which greatly enhances the sensitivity, selectivity and reduces interference from close by stations. Covering FM 87-108 MHz, SW 1.711 – 29.999 MHz, MW 522 – 1620 kHz, LW 100 – 519 kHz..... **£189.95**

MFJ

MFJ Enterprises, founded in 1972 by Martin F. Jue, is a manufacturer of a broad range of products for the hobby radio market. They specialise in station accessories, such as antenna tuners and antenna accessories. MFJ manufactures more amateur radio products than any other company in the world.

Receiving Products

MFJ-1022 300 kHz – 200 MHz active antenna covers the HF to VHF bands. It easily plugs into your general coverage receiver or scanner **£94.95**
MFJ-1020C 300kHz to 30 MHz tuned indoor active antenna system performs as well if not better than a long wire ten metres long. Tuned circuitry minimises intermod, improves selectivity and reduces noise. You can also use it as a tuned preselector with an external antenna **£129.95**
MFJ-1024 50 kHz – 30 MHz active antenna complete with control unit, 15m coax and external antenna **£197.99**
MFJ-1025 1.5-30 MHz noise canceller (alternative to the MFJ-1026) without the built-in Active Antenna. Plug your station antenna into the MFJ-1025 and your antenna system turns into a directional receiving array! **£269.99**
MFJ-1026 This unit is designed to eliminate local electrical noise even before it reaches the antenna socket of the receiver – it covers 1.8-30MHz – great just to only here the wanted signal in the clear. **£279.95**

Bonito

The Bonito brand defines over 38 years of reliable software in the field of worldwide weather data reception on board and of course Ham radio. Bonito is one of the leading software manufacturers for receiving weather information via shortwave radio, such as WeatherFax, Navtex, RTTY, CW and Synop as well as Satellite Fax Images from NOAA, Goes, ESA / EUMETSAT Meteosat. As well in Ham radio Software, SDR-Receiver and active Antennas and many more ham radio and DXer products.

Boni-Whip 20 kHz-300 MHz portable (17cm length) active wideband antenna..... **£109.95**
MA305FT MegActiv 9 kHz -300 MHz portable (30cm length) active wideband antenna..... **£179.95**
POLORAN 200 9kHz – 200 MHz broadband passive loop antenna. **£179.95**
GA3005 GigActiv 9 kHz–3000 MHz portable (19cm length) active wideband antenna..... **£379.95**
MEGALOOP FX 9 kHz – 180 MHz indoor/outdoor flexible loop antenna..... **£349.95**
MD3000X Mega Dipole 9 kHz–180 MHz active wire antenna..... **£389.95**

ALINCO

Alinco is a Japanese manufacturer of radio equipment, established in 1938 in Osaka, Japan and has been a trusted source for radio scanners for years.

Handheld

DJ-X3ED 100 kHz – 1300 MHz AM/FM/WFM 700 channel analogue scanner..... **£119.95**
DJ-X11E 500 kHz – 1300 MHz All mode 1200 channel analogue scanner **£349.95**

Base

DX-R8E 150 kHz – 35 Hz all mode 600 channel receiver..**£469.95**

Accessories

ERW-7 USB computer interface cable for DX-R8E..... **£39.95**
ERW-8 USB Interface cable for DJ-X11scanner..... **£39.95**
ESC-50 soft case for DJ-X11 scanner **£23.95**
EBP-74 replacement 1800mAh battery for DJ-X11 ..... **£34.95**
EDH-36 spare dry cell case for DJ-x11 ..... **£17.95**
EME-26 curly cord earphone..... **£10.95**
EME-6 straight cord earphone **£10.95**
EPB-54N high power battery for DJ-x3..... **£29.95**
EDC-105 drop in charger for DJ-X3..... **£14.95**
EDC-43 DC power cable for DJ-X3..... **£14.99**
EDC-37 12v DC cable for Alinco scanners..... **£9.95**
EDS-17 remote head fitting for DX-SR8 ..... **£49.95**

SDRplay

The people behind SDRplay are a small group of engineers based in the UK with strong connections to the UK Wireless Chip Industry. They have both software and hardware expertise and the RSP was designed by them here in the UK.

RSPDUO is a dual-tuner wideband full featured 14-bit SDR which covers the entire RF spectrum from 1kHz to 2GHz giving 10MHz of spectrum visibility..... **£239.99**
RSPDX covers all frequencies from 1kHz through VLF, LF, MW, HF, VHF, UHF and L-band to 2GHz, with no gaps **£194.95**
RSP-1A it is a powerful wideband full featured 14-bit SDR which covers the RF spectrum from 1kHz to 2GHz. All it needs is a PC and an antenna to provide excellent communications receiver functionality..... **£99.95**

AOR

AOR, LTD is a renowned Japanese communications equipment manufacturer established in 1978, headquartered in Tokyo, Japan, serves the monitoring enthusiasts, communication professionals, amateur radio operators and electronics industries throughout the world

Handheld

AR-8200MK3 super wide band 100 kHz-3000 MHz 1000 channels analogue scanner..... **£459.95**
AR-8200D same as AR-8200-MKIII with the following added features. * APCO25 Decoding * Voice Recording * MicroSD Card Slot * 4GB MicroSD card Included * USB Port * CTCSS built-in * Voice Inversion built-in **£669.95**
AR-DV10 100 kHz-1300 MHz Digital scanner with TETRA DMR. NXDN. dPMR. APCO25. D-STAR **£939.95**

Mobile/Base

AR-8600 MKII 100 kHz-3000 MHz all mode analogue scanner **£649.95**
AR-DV1 100 kHz -1300MHz Multi mode digital base scanner..... . ..... **£1199.00**
AR-5700D 9 kHz – 3700 MHz Advanced digital communications receiver **£4595.00**

Accessories

DA-3200 25-3000 MHz professional discone antenna **£169.95**
DA-5000 700-3000 MHz professional compact discone antenna... ..... **£269.95**
LA-400 10kHz – 500 MHz Magnetic receiving loop **£399.95**

MOONRAKER

THE PERFECT GIFT!

WS200 V2 Professional Solar Weather Station

This Moonraker Weather station utilises a solar panel for the outside unit which sends the collected data to the indoor display unit wirelessly. The indoor unit displays Indoor and outdoor humidity, Indoor and outdoor temperature, Wind speed, Wind direction, Rainfall, Time, Date and available memory **Only £64.99**

AILUNCE HS2 HF/VHF/UHF SDR Transceiver £649.95

HS2 is an ultra-portable full-frequency full-mode SDR radio. Receive frequency coverage 300K~1.6GHZ. The built-in network port can realize remote operation and remote firmware upgrade.

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Radio Astronomy for Amateurs

Andrew Thomas
artwork@silverbirch/me.uk

Andrew Thomas delves into the fascinating history and scope of amateur radio astronomy, suggests some projects that you can engage with and profiles the United Kingdom Amateur Radio Astronomy Association (UKRAA).

Astronomy is a popular hobby and often in the public eye. Spectacular discoveries make international news and popular science programmes on television and radio attract large prime time audiences, just think of Brian Cox on the BBC.

Astronomy is also one of the sciences where amateur observers can still make valuable contributions to our knowledge. An initiative such as *Zooniverse* enables citizen-scientists to participate in real cutting-edge science by classifying data and images.

A team of advanced amateur astronomical imagers collaborated with NASA to plan some observation targets for the JOVE mission to Jupiter.

www.zooniverse.org

Amateur astronomy is predominantly associated with visual observing. Observers use a telescope to observe stars planets and other celestial objects by eye or camera.

However, the light we can see is only part of the total electromagnetic radiation present in the universe. We tend to think it is the most important part simply because we can see it (Fig. 1).

The first person to find invisible radiation was William Herschel in 1800 when he detected infrared light while studying the Sun's spectrum. Observers had to wait for over 130 years for the next window on the universe to open. That opening required the development of a new theory of electromagnetism by James Clerk Maxwell in 1865 and the development of radio by Marconi and many others in the early 20th Century.

The Beginnings

In 1932, Carl Jansky (1905-1950) of Bell Telephone Laboratories in New Jersey was tasked with investigating the background noise which was affecting the long-distance radio links being developed at that time. He mapped the direction this noise came from and noticed that the strongest source moved across the sky at the same rate as the stars.

This phenomenon was dubbed 'cosmic radio waves' in papers for the Institute of Radio Engineers. At the time astronomers took little notice and Jansky moved on to other engineering problems.

At the urging of Bernard Lovell (1913-2012) the UK invested in radio astronomy research. Jodrell Bank's first telescope was built in the 1950s and became a UNESCO World Heritage site in 2019. Since the 1950s radio observations have become a core part of astronomy and led to major discoveries.

Recently an international collaboration combined multiple radio telescopes to form the Event Horizon Telescope equivalent to the size of the Earth. This produced the first image of a black hole (Fig. 3).

Visual observers start using their eyes, and the best next step is to use binoculars to see objects in more detail. Those who become more enthusiastic often move on to a small telescope, and a small number eventually grow into an observatory with complex telescopes and camera equipment.

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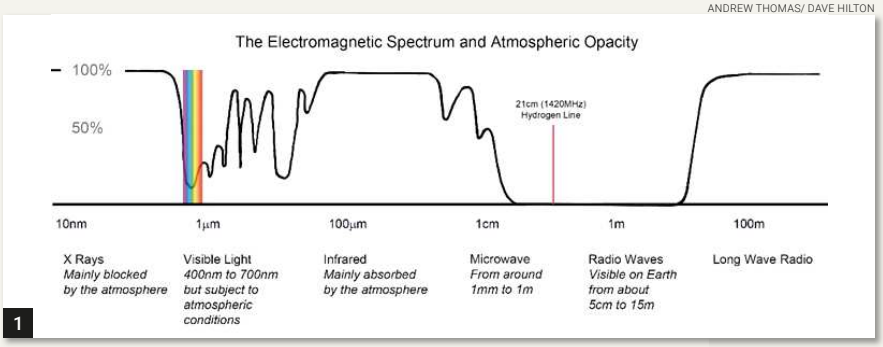

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Beyond Limitations

However, all visual observers suffer from the weather; clear skies are needed. Those in urban areas are limited by light pollution from streetlights, security lights, car lights, and so on.

And the best views of the northern skies are often on cold, clear nights in the depth of winter.

By contrast, radio astronomy is not dependent on clear skies, can be carried out in the daytime and does not involve going out in the cold. I found this is an extremely attractive proposition.

There are several 'entry-level' projects. Some more advanced observers have erected radio dishes able to observe the motion of our galaxy, the Milky Way, and even the flash of pulsars. I am not that advanced an observer, but I have found it fascinating and along the road, I have learnt about radio equipment, electronics, and computers. I even learnt how to write Python computer code.

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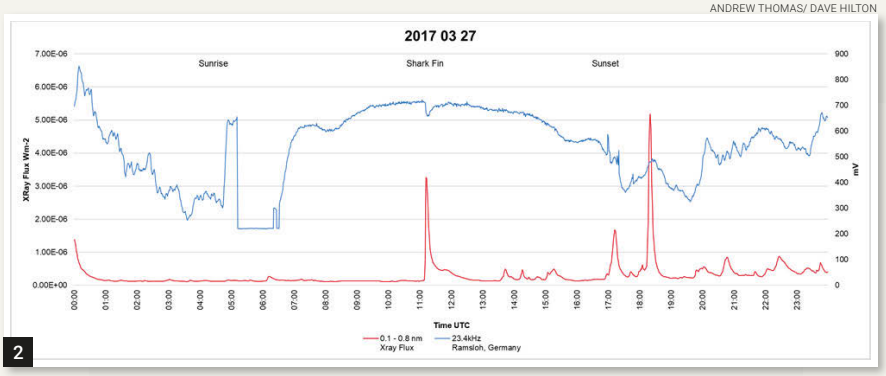

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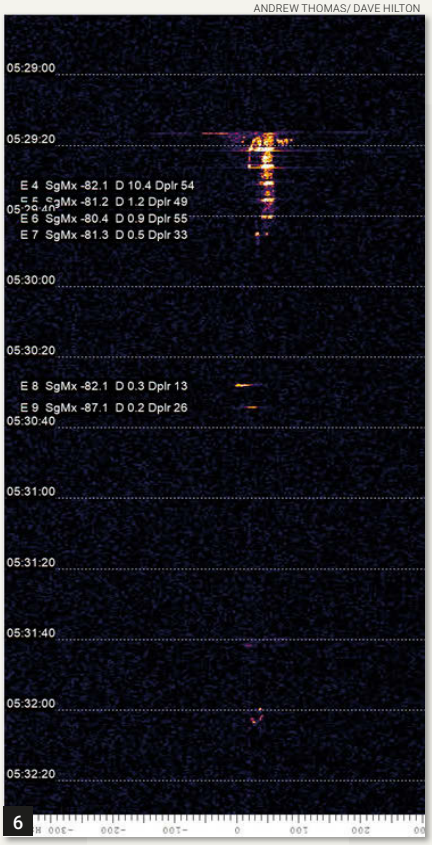

EVENT HORIZON TELESCOPE COLLABORA-

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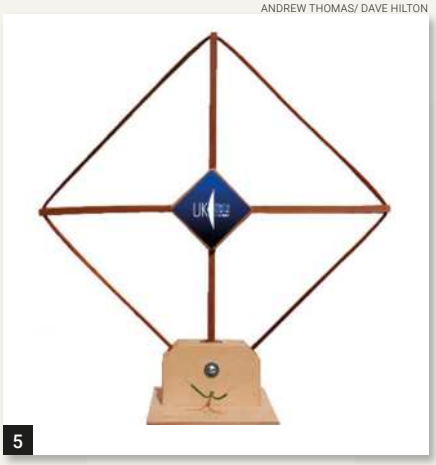

Fig.1: The Electromagnetic (EM) Spectrum detailing radio wavelengths. Fig. 2: VLF signal (blue) showing a SID 'shark fin'. The orange trace shows a spike in solar X-rays measured by NASA's GOES satellite. Fig. 3: The first image of a black hole, at the centre of the galaxy M87. Fig. 4: A homemade aerial for meteor echo reception. Fig. 5: The UKRAA VLF loop aerial. Fig. 6: Meteor Echoes. There is a large echo here, as well as several less pronounced ones from smaller meteors.

Chasing Meteors

The first experimental observations made at Jodrell Bank were of meteors using a war surplus radar set and receivers. Fortunately, this has become much simpler to do and no longer requires your own radar set. When a meteor burns up in the atmosphere it leaves a trail of hot ionised gas in its wake. It is this gas which reflects radio waves, the meteor itself is far too small, most are the size of a grain of sand. When a meteor passes between the transmitter and receiver, the ionised trail reflects the radio signal, and this increases the strength of the received radio transmission.

The French government has kindly provided a powerful radar system, which is ideal for detecting meteors. Its real purpose is to monitor satellites and space junk. The transmitter is called GRAVES and is located near Dijon transmitting at 143.05MHz. There is another beacon called BRAMS in Belgium which is dedicated as a meteor scatter detector and this operates at 49.97Mhz or just under 50Mhz.

The reflected signals can be easily received in the UK (Fig. 4). Receiving them requires an antenna, a radio receiver, and a computer. I built an antenna out of wood and copper water pipe and simply placed it on the shed roof for use.

The simplest way to receive the signal is to use a Software Defined Radio, which is a radio receiver directly controlled by a computer. These are inexpensive but very versatile and useful devices for amateur radio astronomers.

On top of this, I use *Spectrum Lab* to display the signals echoed back from the meteor (Fig. 5).

Spectrum Lab is free to download, and only the SDR and some cables need to be purchased.

www.qsl.net/dl4yhf/spectra1.html

This can be a low-cost DIY project and a good introduction to astronomy and observing meteors.

One interesting observation I made in the past was of the *Perseid* Meteor shower. By recording over several days, I was able to see the number of meteors increasing toward a peak around the 14th August 2018.

Solar Flares

The brightest object in the sky is the Sun, both visually and at radio frequencies. Solar activity directly affects the Earth, solar flares can interfere with radio signals and satellites, and magnetic storms cause the aurora and can disrupt electrical supply systems. Forecasting 'space weather' has become an important branch of science.

The US National Oceanic and Atmospheric Administration (NOAA) website, for example, offers space weather forecasts and plenty of background information.

www.swpc.noaa.gov

Sudden Ionic Disturbances, known as SIDs, are caused by the X-rays emitted from solar flares changing the ionosphere at an altitude around 70km. The Earth's ionosphere is highly effective in protecting us from these X-rays by absorbing them at this altitude.

This changes the way radio waves travel around the Earth and these changes in the signals show when a solar flare occurs.

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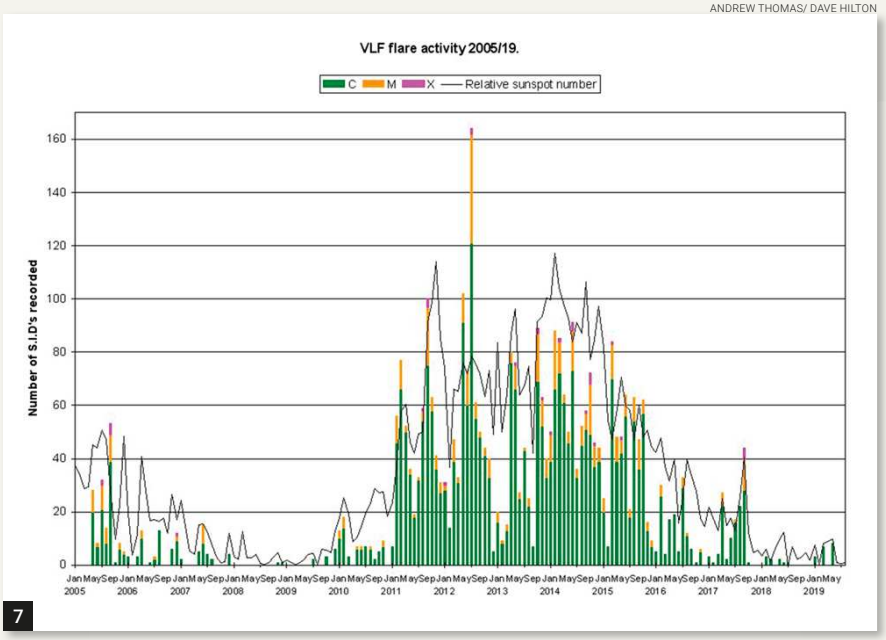

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Fig. 7: SIDs record 2005-2019 showing the solar cycle. Fig. 8: A dish antenna under construction. Fig. 9: This is a suitable radio astronomy primer for the layperson. Fig. 10: This book (and the one by Arnold, 2021) offer easy projects you can build. Fig. 11: This is the latest addition to the Radio Astronomy hobby literature.

I monitor a radio station in Ramsloh in Germany which transmits at 23.4Khz, using a UKRAA loop aerial (Fig. 6).

During a typical day, a slowly-changing signal is received between sunrise and sunset. When a solar flare occurs, there is a sudden change in the signal which looks like a 'shark's fin' (Fig. 3).

The orange trace in Fig. 6 reveals the strength of the solar X-rays measured by NASA's GOES satellite. The spike in X-rays emitted by a solar flare can be seen at just after 11:00. There was an even larger spike at approximately 18:30, which did not cause a SID. This is because it occurred after the Sun had set.

The X-rays were invisible over the UK and Germany and did not affect the ionosphere.

The British Astronomical Association (BAA) Radio Astronomy Section collates the observations from a group of observers and produces a graph of the numbers of SIDs recorded each year. The records for the last 15 years show that the frequency of SIDs follows the 11-year solar sunspot cycle (Fig. 7).

The year 2020 marked the start of a new solar cycle, and so the Sun is currently quiet. Over the next 5 years, the Sun will become increasingly active with more flares and SIDs to record.

Studying the ionosphere and radio propagation remains important to radio amateurs and hobbyists. The VLF signals used to detect SIDs are used by various governments to communicate with submerged submarines and short wave is used for long-distance secure communications as a backup to satellites links.

The two examples described are both projects I have built, and which I contribute regular SIDs observations to the BAA. Neither project needs much more than enthusiasm and a small amount of space in either the house or garden.

Advanced Projects

There are, however, some amateurs who are much more ambitious (Fig. 8): They have built larger telescopes and can observe our Milky Way galaxy in detail. By receiving the 21cm radio signal from Hydrogen molecules in the gas clouds between the stars they have been able to map the shape of the Galaxy and measure its rotation.

At the frontier of amateur radio astronomy, a small group of advanced observers can detect pulsars. This is a major technical achievement with a home installation.

Throughout the Galaxy hydrogen exists in atomic form and, in extremely rare events, an electron can change state emitting energy. When an electron, with a spin that is parallel to the nucleus spin, suddenly 'flips', so that the electron and nucleus are spinning in opposition, this causes the emission of a photon of energy with a frequency of approximately 1420MHz, a wavelength of 21cm. Amateurs can detect and plot the position of galactic hydrogen to produce a survey map of the distribution of hydrogen throughout the Milky Way.

Many amateur projects have succeeded in detecting and mapping Galactic hydrogen. Radio Astronomy dishes of around 2 metres or more are often used (Fig. 8) but also Yagi aerials and waveguide horn antennas are reliable detectors. You can learn more in this interesting video by Dr Laurence Newall on *YouTube*.

https://tinyurl.com/y6pv2gmu

The weak signals are fed to low noise amplifiers (LNAs) and a suitable filter centred around 1420MHz. The signals are processed by software such as *Spectrum Lab* or *Radio Eyes*. By making regular and frequent observations of signals strength over a long period eventually, a map of the hydrogen throughout the Galaxy can be plotted.

You can read about the various amateur projects at this URL:

https://tinyurl.com/yxms8agg

Furthermore, the books in Figs. 9 to 11 can be recommended as introductory reading to this fascinating branch of the radio hobby.

The UK Radio Astronomy Association (UKRAA)

The UK Radio Astronomy Association was established in 2008 as a registered charity (registration no 1123866) by the British Astronomical Association's Radio Astronomy Group (RAG). UKRAA's objectives are to promote the science of radio astronomy and all branches of radio astronomical research.

Before UKRAA's formation, RAG members had designed and built working prototypes of a VLF Receiver and Magnetometer. However, BAA rules did not permit the sale of products under the BAA banner. UKRAA was set up to handle the manufacture and sale of these products and the production of technical manuals covering the use of the products and the background science.

Consequently, over the past 12 years, UKRAA has developed several new radio astronomy products and modules. To promote radio astronomy to amateur astronomers. Members give talks to local astronomical societies and exhibit at astronomy shows. UKRAA regularly attends the *Astrofest* in London, although the 2021

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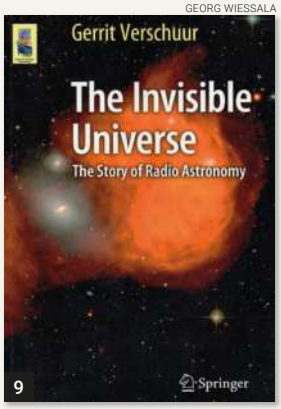

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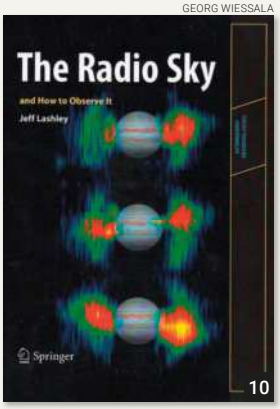

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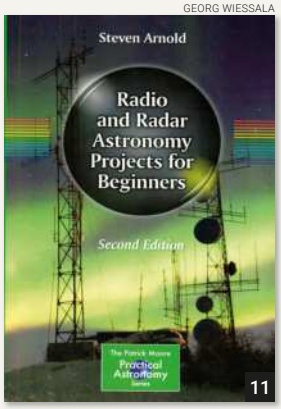

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Further Resources

- Arnold (2021): *Radio and Radar Astronomy Projects for Beginners* (Springer: 2nd ed. 2021)
- BAA (Radio Astronomy Group): VLF Observations: **https://www.britastro.org/node/20957**
- Bradley, M. (2013) 'Monitoring Solar Flares by Radio Astronomy': **https://tinyurl.com/yb9vw454**
- British Astronomical Association (BAA, Radio Astronomy Group) **http://www.britastro.org/radio**
- Fielding, J. (2006/ 2010) *Amateur Radio Astronomy* (RSGB)
- Graham-Smith, F. (2013) *Unsees Cosmos – The Universe in Radio* (Oxford: OUP)
- Judge, P. (2020) *The Sun – A Very Short Introduction* (Oxford: OUP)
- Lashley, J. (2010) *The Radio Sky and How to Observe It* (London: Springer) (Chapter 9 is on a VLF Solar Monitor)
- Palmer, P.I. (2017|) *The Atmosphere – A Very Short Introduction* (Oxford: OUP)
- Sichla, F. (2020) *Kosmische Kommunikation* (Marburg: beam Verlag [in German])
- Verschuur, G. (2015) *The Invisible Universe* (Springer)
- Whitham Reeve Article Collection: **https://tinyurl.com/y2vlzrzf**
- Wiessala, G. (2020) *'Observing the Sun and ono-sphere in VLF'* (RadioUser, December 2020: 34-38)
- Reeve, W.D. (2010) *'Listening to the Sun's Radio Storms'* (RadioUser, March 2010: 34)
- -- (2019) 'Monitoring LF Propagation with a Software-Defined Radio Receiver': **https://tinyurl.com/y69y572a**
- RadioUser Reading List: **https://tinyurl.com/yxoyndx7**

show will probably be an online event. Moreover, UKRAA has provided support to schools and university departments on educational projects. The current Covid restrictions make it difficult to plan for next year. However, if UKRAA plans to attend radio and astronomy shows, this will be announced this on the association's website. **https://www.ukraa.com**

UKRAA consists of a small group of volunteers who design and make the astronomy products sold. In addition to official UKRAA activities, trustees pursue their own interests and observations.

This includes participation in the *European Conference on Amateur Radio Astronomy (EUCARA)* and the (US) *Society of Amateur Radio Astronomers (SARA)*. **https://tinyurl.com/y5taky5u** **https://www.radio-astronomy.org**

All net proceeds from the sale of UKRAA products are spent on radio astronomy development and outreach. The association does not have a 'membership' as such, like the British Astronomical Association.

Nevertheless, UKRAA is always happy to hear from interested hobbyists who may be willing to join in.

UKRAA sells radio astronomy equipment through its online store. There is an extensive range of VLF Receiver equipment, a magnetometer and E-Field equipment. UKRAA is also an authorised distributor of the Lab Jack U3-HV multifunction data acquisition module, which is in widespread use in the radio hobby community.

Last but not least, UKRAA also sells books on radio astronomy suitable for all levels.

*[Andrew Thomas is a Trustee of UKRAA. His long-standing interest in astronomy was re-energised when he discovered amateur radio astronomy. This was a chance encounter at a business conference with a self-declared 'amateur radio astronomer'. Before that, he had no idea that such things were possible. Andrew enjoys building the instruments needed for making observations and encourage others to have a go. Not unlike the editor, he currently observes VLF signals (*RadioUser*, December 2020: 34), ionospheric disturbances and occasionally meteors. Andrew's present project is to add a magnetometer to his observatory and observe the impact on the Earth's magnetic field of the solar wind and coronal mass ejections. The author wishes to convey his sincere thanks to Dave Hilton for providing further input to this article. Dave Hilton is also a trustee of UKRAA. Electronics and astronomy have always been his favourite hobbies. Following retirement after a career lecturing in healthcare technology at Nottingham University, Dave rekindled these interests. A presentation at his local astronomy club by a leading researcher from Jodrell Bank made him realise how accessible radio astronomy could be to the amateur – **Ed.**].*

Games Without Frontiers & Songs Without Tears

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Keith Hamer and Garry Smith shed some light on the work of the European Broadcasting Union (EBU), whose activities encompass so much more than the annual Eurovision Contest.

The European Broadcasting Union (EBU, Fig. 1) is, easily, one of the most successful aspects of European unification and the European spirit. It was formed 70 years ago, on February 12th, 1950. Since then, this much-respected organisation has developed immeasurably, particularly due to its international network, *Eurovision*.

Nowadays, if virtually all television viewers throughout the world were asked what 'Eurovision' means to them, many would immediately reply, *"the Eurovision Song Contest"*. This flagship event is shown 'live' in almost every country, with notable exceptions, such as China, where the transmission is deliberately delayed.

It has been estimated that the total potential worldwide television audience is approximately 4.2 billion people, of whom, 186-million tuned in to the 2019 extravaganza, held in Tel Aviv, Israel. The UK, along with Germany, France, Italy and Spain (the *'Big Five'*), have automatic entry to the grand final because they pay the most towards the EBU's day-to-day running costs.

To mark the 60th music festival in 2015, the EBU changed its normal rules as a 'one-off' gesture and allowed Australia to participate as an associate member (they came fifth). The rule-change was such a success that the SBS (Special Broadcasting Service Corporation, based in Sydney) now enters regularly. The programme was broadcast live from the Wiener Stadthalle (Vienna) by the Austrian national television service, ORF (*Österreichischer Rundfunk*). It was broadcast to 45 countries including, for the first time, China.

The viewing figures were lower for the special non-competitive version of the programme in 2020 which was re-arranged at short notice due to the coronavirus (COVID-19) pandemic. The event was held in Rotterdam, and each country was allowed to present their own version because the usual voting system had been cancelled. For instance, although all EBU members followed an agreed basic version of the programme, the German presentation from *Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland - Norddeutscher Rundfunk,* (*ARD-NDR*) was completely different to the BBC broadcast.

In reality, the annual songfest is only a small, but extremely important, part of the day-to-day technical activities undertaken by the show's organisers, the EBU. Originally, the EBU Technical Centre was located inside the Palais de Justice in Brussels and the Administration Centre based in Geneva, Switzerland. Today, both centres are situated in Geneva. There is a strict bilingual policy whereby everything is, as far as possible, written and spoken in both French and English.

EBU Innovation

The Eurovision Song Contest is organised by the European Broadcasting Union / Union Européenne De Radiodiffusion (EBU/UER), formed in 1950 by 23 radio and television services from Europe and the Mediterranean at a conference in Devon. The EBU/UER was established as a forum between broadcasters to discuss and develop technical innovations. However, it became responsible for the exchange of programmes between members and associate members, via the *Eurovision* Network. By 1954, there were 24 members from broadcasting organisations in Europe and 12 associates in the USA and the 'Dominions'. Even in 2020, only one broadcasting organisation in each country is allowed to be an 'active' member.

In the UK, this honour falls exclusively to the BBC. Back in the 1950s, the EBU carried out many technical investigations including different sound recording techniques, the choice of intermediate frequencies for TV sets, a system for making better use of the international common waves in the MW band, and the development of unattended stations. Moreover, experiments were conducted into the propagation of radio waves, and a technical monitoring station was maintained to collate frequency measurements and other observations. This station was transferred in 1953 from Brussels to a new building at Jurbise-Masnuy near Mons (Belgium).

First Programme Exchanges

In June 1954, Montreux – nestling on the shores of Lac Léman – became the venue for the first transmission via the EBU's Eurovision Network of the *Narcissus Festival* and its flower-bedecked processional floats. The first *Eurovision* viewers eagerly watched on four million television sets in homes, bars, and shop windows in Germany, Belgium, France, the United Kingdom, Italy, the Netherlands and, of course, Switzerland.

The first *Eurovision Song Contest* was held in 1956 and came from the Teatro Kursaal (Casino Theatre) in the tranquil Ticino city of Lugano in neutral Switzerland. Seven countries took part, including Switzerland (SRG-SSR), Belgium (INT), West Germany (ARD), France (ORTF), Luxembourg (CLT), Italy (RAI), and The Netherlands (NTS). In true typical style, the United Kingdom (BBC) didn't take part because they missed the entry deadline set by the EBU. Austria (ORF) and Denmark (DR) also missed the first Eurovision Song Contest.

This first event included two songs from each country and lasted for one hour and 40 minutes. The winner was Lys Assias who represented Switzerland with the song, *Refrain*. The whole concept of such a show had been invented at an EBU meeting in Monaco in 1955.

The programme was originally intended for a radio audience because there were so few television receivers in Europe in 1956. Television cameras were also in short supply; fortunately, it appears that at least two were conjured up in time for the 'live' transmission.

The Eurovision Song Contest has been a favourite with some television viewers for years. Europe, and indeed the whole world

EBU

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(via satellite) absolutely love it.

Especially the Germans who hold huge and amazing street parties before and after the show!

*[all of which the editor remembers well, from his misspent youth! - **Ed.**].*

European Culture for New Year

For lovers of classical music, the annual New Year's Day Concert from Vienna is a *must*. The programme is produced by ORF and broadcast live throughout Europe and beyond via the Eurovision network. The programme is always in two parts, and BBC viewers are restricted to just the second half. Another strange phenomenon about the BBC's broadcast is that it is the only station to omit the opening Eurovision sequence. Because of this, UK viewers are also denied hearing the Eurovision fanfare theme tune, used for all programme exchanges since 1956.

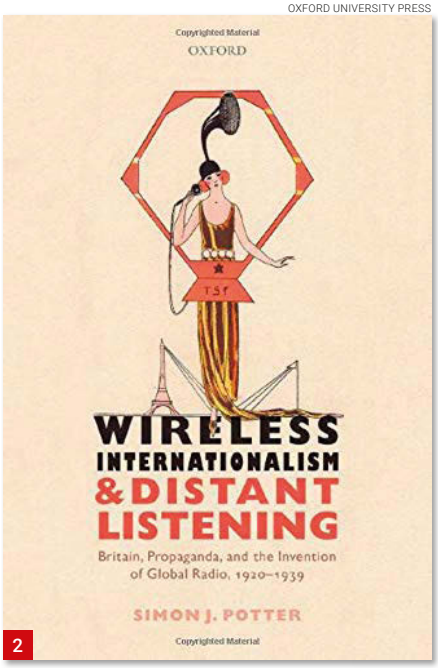
This tune is the first of six original motets composed in the late 1600s by the French Baroque composer, Marc-Antoine Charpentier (1643-1704). The section chosen by the EBU for all their Eurovision exchanges is the *Prelude (Marche en rondeau)* to *Te Deum in D Major, H. 146*. The EBU's arrangement is by Guy Lambert, a 20th-Century French organist famous for his transcriptions of Charpentier's music, and directed by the French conductor, Louis Martini who died in 2000. The *H. 146* refers to the American musicologist who catalogued most of Charpentier's manuscripts, Hugh Wiley Hitchcock.
https://tinyurl.com/y2zz7dff

Wireless Internationalism

Although the EBU was constituted in 1950, the history of programme sharing between European broadcasters begins earlier. In 1925, driven by the birth of radio broadcasting across Europe, the EBU's predecessor, the *International Broadcasting Union* (IBU) was established in Geneva, Switzerland. Many broadcasting services supported the creation of the IBU, but the chief protagonist was the first Managing Director of the BBC, John Reith.

Reith had a simple and lasting vision for public service broadcasting, which has echoed down through the ages: the task of all broadcasters should be to

OXFORD UNIVERSITY PRESS



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"educate, inform, and entertain" (*RadioUser*, November 2020: 25-27). Reith instructed his best staff to serve the IBU and attend all its committees. Arthur Burrows was the IBU's first Secretary-General, in addition to being the BBC's first Director of Programmes.

As well as making sure their members had the airwave frequencies they needed, the multi-national staff of the IBU made a concerted effort over the next fifteen years to advance the idea that the IBU and broadcasters could help people of different nations to understand each other and, in the process, engender peace and harmony.

This was an early form of *Wireless Internationalism* (Fig. 2). It would unfold by bringing programme content, ideas, and techniques, created in one country, to many others.

Arthur Burrows left the IBU in 1941. He was disillusioned that World War II had come despite his dream of world-wide peace. Fortunately, his ideal lived on in 1950 when the EBU was formed. Although the war years had severely reduced progress in international co-operation, by 1950, broadcasters from Western Europe eventually came together and met in a hotel in Torquay on the English Riviera, to establish the European Broadcasting Union.

The Beginnings of the OIRT

Meanwhile, Eastern European broadcasters created their own organisation - the *International Radio and Television Network*. The organisation

IBU

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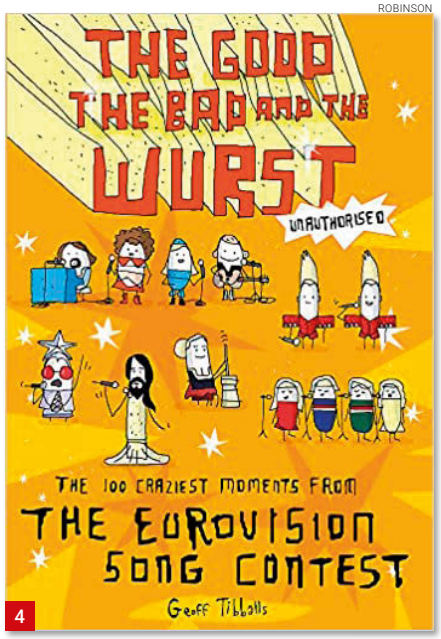

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Fig.1: The famous EBU logo. Fig. 2: The wider context: Wireless Europeanness. Fig. 3: The OIRT emblem. Fig. 4: Geoff Tibball's 2016 book will make you laugh. Fig. 5: Chris West (2020) offers a more serious look at the often-ridiculed event.

adopted the French language and so was officially known as the *Organisation Internationale de Radiodiffusion et de Télévision* (OIRT, Fig. 3). The OIRT, based in Prague, was formed on June 28th, 1946. Its version of *Eurovision* was called *Intervision*. Following the collapse of the communist systems in Central and Eastern Europe, the OIRT was dissolved on January 1st, 1993, and its members joined forces with the EBU. However, the original *OIRT FM Band* still survives. Besides EBU and OIRT, another organisation, the *Asia-Pacific Broadcasting Union*, was formed on July 1st, 1964. The ABU Secretariat is in Angkasapuri, Kuala Lumpur, Malaysia, and the organisation currently has 286 Members in 57 countries and regions, reaching a potential audience of approximately 3 billion people.

Other bodies exist in other parts of the world, for example, the African Union of Broadcasting (AUB).

1950 The first international television link between France and the UK was made. British viewers were able to watch a festival taking place in the town of Calais, including a firework display at the *Place de l'Hôtel de Ville*.

1953 The Coronation of Elizabeth II was the first event to be broadcast 'live' internationally. People crowded in front of the few available television sets to see the magic happen.

1954 The Eurovision television network was launched with a live transmission from the *Narcissus Festival* in Montreux, Switzerland. The transmission was relayed simultaneously in Belgium, Denmark, France, Germany, Italy, The Netherlands, and the UK.

1956 The first *Eurovision Song Contest* took place in Lugano, Switzerland on May 10th. Seven countries participated in this historic event and a total of 10 national broadcasters transmitted the show 'live' to audiences at home.

1958 The first exchange of news between EBU members took place with 'live' images from the Vatican on the death of Pope Pius XII. The News Exchange officially launched a few years later in 1961.

1960 The EBU bought the rights to the Rome Olympic Games for $1.2-million. This was the first of many collective rights agreements.

1962 The first transmissions between North America and Europe were made using the Telstar satellite, a spherical satellite about the size of a large football (*RadioUser*, March 2019: 36-38; May 2019: 42-44).

1965 *Jeux Sans Frontières* (known in the UK as *It's a Knockout*) was launched as a Europe-wide television game show.

1967 *The Music Exchange* launched its first concert season, starting with the *English Chamber Orchestra* at the *Queen Elizabeth Hall* in London. In the same year, the EBU presented a television programme experience far beyond the technical imagination of the era. A host of early-generation satellites, a million kilometres of cable, thousands of people behind the scenes, and four-hundred million viewers watching across the world in 24 countries culminated in the ground-breaking 3-hour 'live' programme called *Our World*. The programme included The Beatles performing *All You Need Is Love*. The front page of the *Radio Times* featured a colour photograph of a satellite ground station dish aerial. The dreams of Arthur Burrows and Marcel Bezençon were coming true and flourished in the years that followed.

1969 With technical support from the EBU, the organisation's members transmitted the Apollo 11 Moon Landing. This was the first DX-TV signal that the authors received via Norsk Rikskringkasting (NRK) in Norway.

1974 The EBU received an international Emmy Award for the design of a World standard for digital television, accepted by the ITU.

1975 EBU members encouraged the adoption of *Teletext*, following the BBC's launch of *Ceefax* (the first Teletext information service).

1992 The International Radio & Television Organisation (OIRT, broadcasters from Central and Eastern Europe) merged with the EBU.

1993 The Digital Video Broadcasting (DVB) project helped set digital broadcasting standards for much of the world.

1995 The EBU was central to an agreement on a common worldwide standard for digital radio at the ITU.

1998 Working with the ITU, the EBU helped to achieve a world-wide standard for high-definition television.

2003 The first *Junior Eurovision Song Contest* was broadcast live from Copenhagen.

2011 The EBU initiated a *Loudness Revolution* resulting in an international agreement to address disparate levels of volume between programming, trailers, and advertising. Broadcasters in the UK signed up to this agreement but have surreptitiously re-introduced the practice whereby sound levels of trailers and commercials are far higher than the programmes, to attract viewers' attention.

2012 The EBU promulgated the technical standard for ultra-high-definition television with the ITU. The standard enabled the Japanese television service, NHK (日本放送協会, Nippon Hōsō Kyōkai), and the BBC to produce parts of the London Olympic Games in UHDTV. This was the EBU's biggest-ever operation.

2015 The EBU worked with Belgian member VRT (*Vlaamse Radio- en Televisieomroeporganisatie*) to create the World's first 'live' production studio using solely IP (Internet Protocol) technology.

2018 The inaugural European Championships were introduced. This was a new multi-sport

Table 1: Some Key EBU Achievements.

At the EBU, from the early years, Marcel Bezençon worked with a team in the EBU, to render content from one country available to broadcasters in other nations. After only a few years, all EBU members saw the value of this amazing work when the *Eurovision* network was born.

The actual name *Eurovision* was initiated by journalist, George Campey. *Eurovision* is now a vast technical system providing a host of media interconnections not only across Europe but also throughout the world.

Watch virtually any television news bulletin or listen to any major international radio report and all the information will have been delivered over the *Eurovision* network.

Such is the ever-increasing demand for instant communication facilities, the organisation now operates a technical network subsidiary (*Eurovision Services*), which serves companies in the media and event industries.

News, Music and Sport

In the early days of Eurovision, it soon became apparent that the network could be used for various other exchange purposes. Three types of programme content, in particular, seemed suitable to exchange, due to their universal interest. These were (and still are) news, music, and sport.

First, arrangements for news content exchange between members were established early on, with the *News Exchange* launching in 1961 and continuing to this day.

Second, music exchanges were first organised by the pre-EBU organisation, the IBU. Music was is a universal language readily enjoyed across the World.

Third, and concerning sport, the EBU began to collectively purchase the rights for coverage of major sporting events. Today, it brings over 170 major sporting events to millions of viewers across Europe and beyond.

European Programme Formats

In the mid-Fifties, EBU members were offered proposals for two programme formats, initially suggested by some of them. These seemed likely to appeal across all nations.

The first category was (a pan-European version of) the *San Remo Song Festival*. This was the original format of the *Eurovision Song Contest* and it was based on this festival, suitably modified by Marcel Bezençon. In 1950, w Bezençon as appointed as Director-General of the Swiss national broadcasting service, *Schweizerische Radio- und Fernsehgesellschaft/Société Suisse de Radiodiffusion et Télévision* (SRG-SSR).

The second Europe-wide programme format was a pan-European version of a national TV show to be called *Top Town*, in which individual towns put up teams to play games with other locations.

These two proved amazingly successful in their international forms. The first one

became the *Eurovision Song Contest*. ABBA, and countless others, have made their names due to this event, and it is now viewed by up to 200 million enthusiastic aficionados every year. This makes it the most successful entertainment show ever made.

The second programme suggestion became *Jeux Sans Frontières*, better known in the UK as *It's a Knockout*. The show, hosted by a variety of well-known personalities was a truly international event with various alternative titles, including *Spiel Ohne Grenzen* (German), *Spel Zonder Grenzen* (Dutch/Flemish), *Giochi Senza Frontiere* (Italian), *Igre Bez Granica* (Serbo-Croat), *Jogos Sem Fronteiras* (Portuguese), and Παιχνίδια Χωρίς Σύνορα (Greek).

EBU Spearheads New Technology

However, next to Eurovision and Games, the EBU has always been at the forefront of technical progress. In the late 1950s and early 1960s, it was actively involved with the development of colour television, analogue radio systems, and the planning of the way the airwaves were used internationally since the days of the IBU.

In this way, the EBU's work assisted with the introduction of frequency plans for both satellite and terrestrial broadcasting.

The organisation has since implemented many Europe-wide production technology guidelines and standards.

Although the EBU cannot claim to have invented digital television in the early 1980s, without them, the technology would have been incomplete. The EBU – working in close co-operation with other broadcasting unions and the SMPTE (Society of Motion Picture and Television Engineers) – persuaded the world to adopt a common technical standard for digital television in 1982.

https://www.smpte.org

This became known as *ITU Recommendation 601*. This is the technical standard all-digital vision systems have subsequently adopted, from standard-definition television to today's ultra-high-definition television.

https://www.itu.int/rec/R-REC-BT.601

In 1988, the EBU supported Digital Audio Broadcasting (DAB) and (in 1993) the organisation was instrumental in setting up the *DVB Project* to bring digital television to viewers around the world. The latest estimates reveal that last year (2020) over 1.5 billion viewers throughout the world used DVB (Digital Video Broadcasting) systems.

MELVILLE HOUSE UK

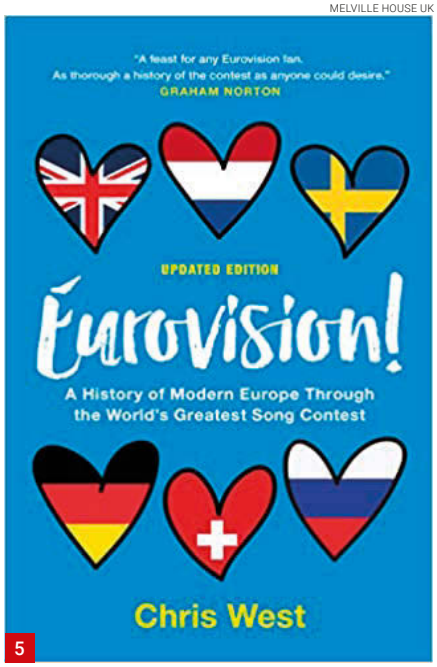

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Table 1 shows some of the major milestones in the EBU's long and distinguished history.

Looking to the Future

Today, the EBU is the globally leading alliance of Public Service Media (PSM). It is convinced that strong PSM must be at the centre of democratic societies. The organisation is committed to championing and upholding its unique value at both a national and international level. In 2021, the EBU represents 116 member organisations in 56 countries in Europe, North Africa, and the Middle East. It has 33 associate PSM organisations in the Americas, Asia, Africa, and Australasia.

The organisation's business arm, *Eurovision Media Services*, enables media organisations and sports federations to maximise their content value by producing and delivering relevant sport, news, entertainment, and cultural content. Currently, approximately 430 staff of more than 40 nationalities work at EBU HQ in Geneva.

There are also worldwide facilities and subsidiaries in Beijing, Moscow, New York, Rome, Singapore, Washington DC, and Brussels. Members operate almost 2,000 television, radio and online channels and services, offering a wealth of content across platforms. Together, they reach audiences of more than one billion people around the world, broadcasting in more than 160 languages.

The EBU has made a long and successful pan-European journey since 1950. We hope that they will continue to strive, and succeed, to make even more amazing technological innovations over the next 70 years!

Table 2 will lead you to a wealth of further resources to accompany this article. These also demonstrate how the subject of pan-European broadcasting and content-sharing has been debated over the last few decades.

The books in Figs. 4 and 5 offer a light-hearted – yet historically accurate and pertinent – reflection of the Continent's most famous EBU initiative, including its diplomatic aspects.

- African Union of Broadcasting (AUB) **http://www.uar-aub.org**
- Asia-Pacific Broadcasting Union **https://www.abu.org.my**
- Collins, R. (1998): *From Satellite to Single Market: New Communication Technology and European Public Service Television* (Routledge)
- EBU Publications **https://tinyurl.com/y6de7a99**
- EBU Timeline **https://tinyurl.com/y43n26q4**
- European Broadcasting Union (EBU) **https://www.ebu.ch/home**
- Eurovision-TV: **https://eurovision.tv**
- Heinrich-Franke, C. (2010) *'Creating Transnationality through an International Organization - The European Broadcasting Union's (EBU) Television Programme Activities'* - Media History (Vol. 16/2020: 67-81) **https://tinyurl.com/y5focnj2**
- Kalman, J. et al (2019) *Eurovisions: Identity and the International Politics of the Eurovision Song Contest Since 1956* (Palgrave Macmillan)
- Kennedy O'Connor, J. (2010) *The Eurovision Song Contest: The Official History* (Carlton)
- North American Broadcasters' Association **https://nabanet.com**
- Tibbals, J (2016) *The Good, the Bad and the Wurst: The 100 Craziest Moments from the Eurovision Song Contest* (Robinson)
- Vuletic, D. (2019): *Postwar Europe and the Eurovision Song Contest* (Bloomsbury Academic)
- West, C. (2020): *Eurovision! A History of Modern Europe Through the World's Greatest Song Contest* (Melville)
- World Broadcasting Unions **https://worldbroadcastingunions.org**

Table 2: Further Reading and Resources.

The Wonder of the Transistor

Geoffrey Evans
redwoods@waitrose.com

Geoffrey Evans, the author of a recent book on the history of the transistor, investigates the pivotal role this component has played in the mind-boggling advances in electronics.

Once, when I mentioned to someone that I was working with transistors, he said, *"They are a kind of small pocket radio aren't they"?* This made me think: advertisers have a history of confusing the public. We are still apt to call any make of vacuum cleaner a '*Hoover*' or any search engine '*Google*'.

However the transistor is such an incredible and world-changing device, it deserves better.

Most new inventions are the culmination of the work of those of earlier times. Usually, to become feasible, they have to await the availability of new materials and machinery. The transistor is no exception.

The appearance of a practical transistor had hovered covertly for over 100 years. It can be argued that its ancestry can be traced back to James Clerk Maxwell in 1873 and his discovery of electromagnetic waves.

Then, we had to await insights (however slight) into quantum physics. A Russian, Oleg Losev (1903-1942), almost succeeded in making a transistor but was thwarted by his death in the Siege of Leningrad in 1942 at the age of only 38. Finally, things were brought to a head in 1947 when John Bardeen, Walter Brattain and William Shockley demonstrated a working model of a transistor at Bell Labs USA (Fig. 1). The three physicists who invented the transistor were awarded the Nobel Prize.

Early Developments and Cat's Whiskers

The first commercially available transistors were similar to the 'cat's whisker' diodes of the early crystal radio sets except that they used two whiskers. They were called 'point-contact' transistors and used crystals of germanium, a semiconductor element. It brought a shock to those of us brought up with radio valves. We found it difficult to adjust from the voltage-driven valve to the current-driven transistor, and it took a while to adjust to a new circuit design mentality. I first became acquainted with the transistor at a lecture by a physicist at Borough Polytechnic. He started by writing

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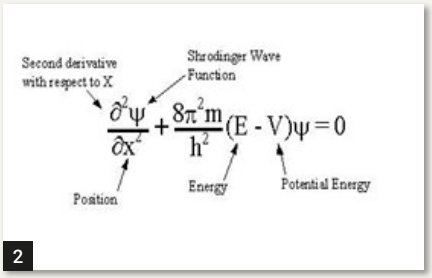

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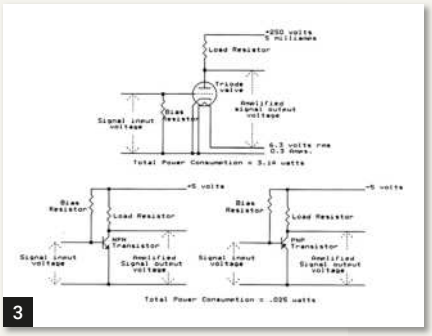
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Fig.1: A replica of the first working Point Contact transistor invented in 1947. Fig. 2: Schrödinger's Formula for calculating the wave function for an object. Fig. 3: The Philips booklet on circuit-comparison between the valve and the transistor. Fig. 4: A valve and a match, compared with an earlier and later transistor. The active areas of the transistors are minute compared with the size of their cases.

Schrödinger's Equation on the blackboard (Fig. 2) – "to calculate the wave function for an object", he said.

I, and the rest of the audience, left the lecture theatre bemused and none the wiser.

Fortunately, the Philips company published a series of pragmatic technical booklets; one of them showed that it was only a small step to appreciate the circuit comparison between the valve and the transistor (Fig. 3).

Soon the delicate, point-contact, cat's "whiskers" were replaced by junction transistors. These were solid, more rugged and easier to manufacture. These comprised a crystal of the semiconductor, germanium that was doped to provide three layers separated by junctions.

The performance limitations and poor reliability of these early devices delayed the replacement of the radio valve. Their highest operating frequency was less than 1MHz, making a medium wave superhet radio a non-starter. Also, they were only suitable for low power applications. Even when power transistors did become available were they prone to unexplained catastrophic failures.

Germanium was particularly susceptible to moisture; therefore, the problem of watertight sealing of its encapsulation had to be overcome. I remember being given some early and precious germanium transistors from the USA and being tasked with suspending them over a container of water to test their waterproof quality.

They all failed after a few days.

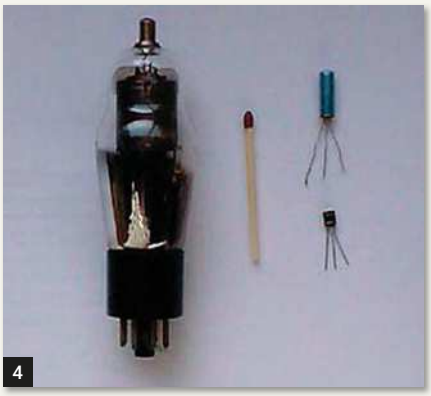
As some of us may have found when we drop our mobile phone in the bath, there is nothing that electronics dislikes more than water!

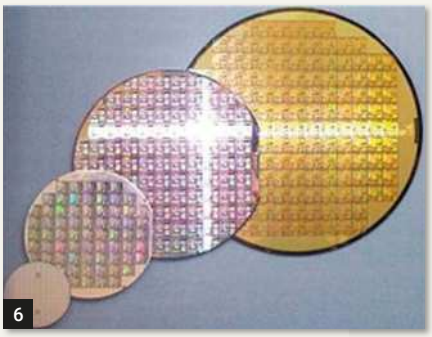
The First Transistor Radios

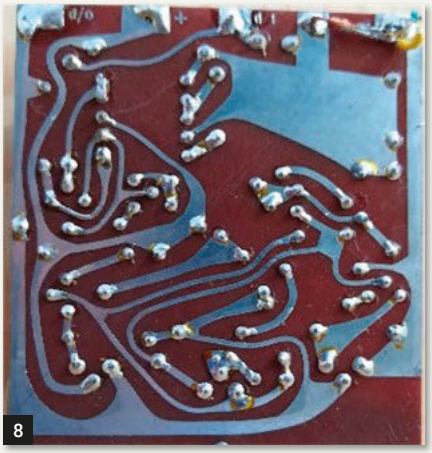
As the design of the junction transistor improved, pocket-size transistor radios appeared in 1954. The first, the Regency TR-1 used four transistors. Regretfully, from that point in time, manufacturers diverted the public's attention away from the potential wonders of the transistor by calling their radio products 'Transistors'.

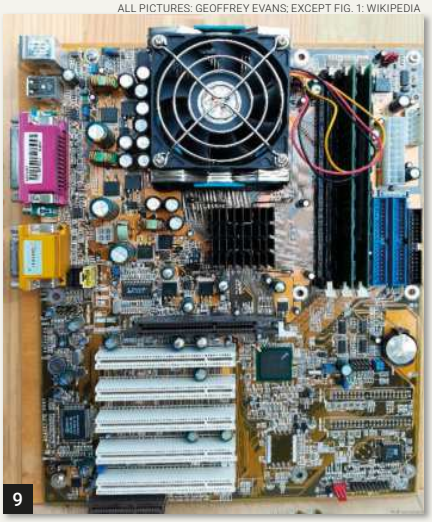
The limitations of Germanium were overcome when, in 1954, the first working transistor made with silicon appeared. Silicon, another semiconductor element,

ALL PICTURES: GEOFFREY EVANS; EXCEPT FIG. 1: WIKIPEDIA









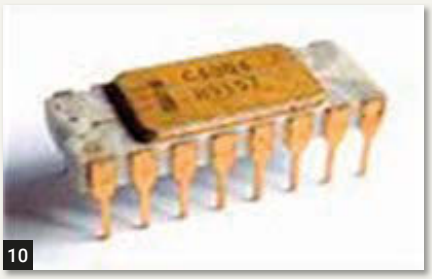


Fig. 5: A grown crystal of pure silicon. Fig. 6: Silicon wafers from 2 to 8" in diameter with multiple chips. Fig. 7: A 1950s valve amplifier with its equivalent (an integrated circuit) in a 'dual in-line case', next to a 10p piece. Fig. 8: A simple, single layer, printed circuit board (copper-side). Fig. 9: An early multi-layer printed circuit motherboard. It contains over a million transistors. The components were mounted automatically. The CPU is at the top, under the grill of the cooling fan. Fig. 10: An early Intel 4004 Microprocessor. Fig.11: Illustration of the workings of a Junction Transistor. Fig.12: The author's recent book on the development of the transistor.

offered major prospects for the future, with its better electrical characteristics, lower leakage current and less temperature sensitivity. By 2012, it was said to account for over 90% of all semiconductor and solar cell production.

The size of the encapsulation of these early devices veiled the size of the silicon crystal inside, Even that disguised the size of the useful working part of the crystal. However, a component needed to be of a size that could be handled and assembled into a circuit (Fig. 4).

Table 1 shows the sizes and prices of transistors, over time.

The silicon needed to be extremely pure, so large crystals were grown artificially (Fig. 5). The crystals were then sliced into wafers and arrays of identical transistors were created (Fig. 6).

These were then cut into individual chips.

Chips became available containing six or more transistors encapsulated in a plastic 'dual in-line' case.

Integrated Circuits and MOS FETs

The next stage in development was to find a way to use silicon to emulate resistors, capacitors and inductors – the essential components for all electronic circuits.

Its achievement opened the way for fully solid-state circuits on a chip, instead of an array of separate components that had to be mounted and wired together.

These were called 'integrated circuits'. The image in Fig. 7 shows a 1950's valve ampilifier with its integrated circuit

Another far-reaching milestone was reached in 1959, with the advent of a different kind of transistor. It was called the MOS FET (Thus saving us the bother of having to write 'Metal Oxide Silicon Field Effect Transistor').

The MOS FET, invented by Mohamed Atallah and Dawon Kahng at Bell Labs, was the first truly compact transistor that could be mass-produced. It paved the way for very high-density Large Scale Integrated (LSI) circuits and dramatically changed our lives. It led to highly complex systems shrunken down to just one chip. Instead of a mass of wires and large

components, one now sees a printed circuit board populated with diminutive plastic packages each containing innumerable transistors. These are manufactured automatically at low prices.

The first true electronic pocket calculator the *Busicom LE-120A HANDY* was launched in 1971. It used a single MOS LSI calculator-on-a-chip. By 2020, transistor sizes and numbers of transistors on a silicon chip have become truly mind-boggling, as illustrated in Table 2.

In 2019, the new artificial intelligence (AI) company, *Cerebras Systems*, unveiled the largest semiconductor chip ever built. It was specifically designed to process artificial intelligence applications and has an incredible 1.2 trillion transistors

The advance of Silicon chips from those containing only 1 transistor, to the modern ones with over a trillion transistors, over just 70 years is, therefore, nothing less than astounding.

Frequencies and PCBs

Furthermore, the operating frequency of a transistor (the speed at which it can switch on and off) has increased by an astonishing extent; from 1MHz in 1951 to over 600GHz (600,000,000,000 Hz) today.

Typically it is half a millionth of a metre long and can carry out 600 billion operations every second.

However, not unlike a horse with its carriage, the transistor needed a synergetic partner.

It found it in the printed circuit.

The first printed circuits were made on a plastic board covered with a thin layer of copper sheet. The copper was etched away chemically to leave a circuit configuration of copper 'wires'. The transistors and their associated components were mounted on the non-copper side of the board with their leads through holes and soldered to the copper 'wires' (Fig. 8). This system lent itself to automatic production.

The increase in the complexity of circuits threatened to over-crowd the simple printed circuit board.

This was overcome by an incredible development that sandwiched several thin printed circuit boards to make a 3D multi-layer board (Fig. 9). Later, 'surface-mount' LSIs were produced with flat feet instead of wires so that they could be soldered automatically to the copper outer surface by a process of 'flow soldering'.

Another milestone was reached in 1971

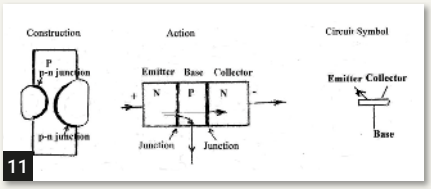
	Anode Voltage	Power Output	Power Supply	Today's price, each, of a Valve/Transistor
Small signal valve	250	N/A	4W	£40
Small signal transistor	5	N/A	<100mW	5p
Class B amplifier valves (2)	450	15W	56W	£30.00
Class B amplifier transistors (2)	30W	60W	90W	£1.26

Table 1: Voltage, Power Values, and Prices of Transistors Over Time.

Date	Transistor size	Number of Transistors on Chip
1950	1 cm	1
1971	10 micrometre(0.000,001 metre)	22,590
2020	5 nanometre (0.000,000,005 metre)	10,000,000,000

A silicon atom = 0.21 nanometre (diameter of an average hair = 0.07 millimetre).

Table 2: The Evolution of Transistor Sizes and Numbers on a Chip.



11

when the first commercial microprocessor chip, the Central Processing Unit (CPU) of a computer, was launched. This first chip was made by *Intel* and called the *4004*. It contained 2,300 transistors of 10 microns in size (Fig. 10).

The main component on a motherboard is a Central Processing Unit (CPU). This is the controlling core of a computer. Today, a typical CPU contains billions of transistors.

Custom-Design and Applications

Computer chips soon inspired the production of custom-designed silicon chips that could provide circuits for many applications. Today, they are found in a myriad of uses such as medicine, transport, television receivers, domestic appliances, watches, musical instruments, mobile phones AI robotics, drones, prosthetics, and many more. Many different makes of a product may contain the same silicon chip. Their prices may vary enormously due only to the outward appearance, the brand name and advertising – rather like toothpaste.

It was the minute size of the MOS FET that has led to the marvels of modern technology. By 2018, an estimated total of 13 sextillion (1,000,000,000,000,000,000,000) MOS transistors had been manufactured.

We have travelled from an invention in 1947 to a fantasy world of marvels; and we still have far to go, probably using quantum

How Does a Junction Transistor Work?

Most of us are aware of the workings of a Thermionic Valve, but here is a reminder:

1. A heated cathode bubbles with electrons that remain captured by its surface; much like the gasses on the surface of the sun. (Only somewhat smaller).
2. When the anode 'plate' is given a positive potential, the electrons are attracted away from the cathode to be 'sucked up' by the anode.
3. A grid, inserted between the cathode and the anode, has a negative potential relative to the cathode, which dissuades the electrons from reaching the anode. The number of electrons that get through depends on the size of the grid/cathode potential.

All this takes place in a vacuum and is inefficient. The valve is large, relatively unreliable, and requires a cathode heating element and a high anode voltage. With a junction transistor, a solid, tiny silicon 'sandwich' replaces the vacuum. One 'slice of bread', called the 'emitter', takes the place of the valve's cathode. The other slice, called the 'collector', replaces the valve's anode. The valve's grid is the filling of the sandwich and is called the 'base'. Unlike a ham sandwich, however, it is not made of three layers stuck together. It is a silicon crystal that has been cleverly 'doped' to create the three active layers with junctions in between (Fig. 11).

A Silicon Crystal Junction Transistor: There are two types of the junction transistor. One operates with a negative voltage on the collector concerning the emitter (an 'NPN-type'). With the other, (a 'PNP-type'), the potentials are reversed.

1. The junction between the emitter and the base 'bubbles' with electrons that remain captured by the surface of the emitter.
2. When the collector is given a negative potential (NPN type), the electrons are attracted away from the emitter to be 'sucked' in by the collector.
3. The base, between the emitter and the collector, has a negative potential relative to the cathode, which dissuades the electrons from reaching the collector. The number of them that get through depends on the size of the base/emitter current.

The device is very efficient, is tiny and requires only a low voltage.

Further Resources

- Basics and Functions (Rohm): **https://tinyurl.com/upsqdh3**
- Davidson, Robert: *'Irresistible Transistor Radios'* RadioUser, September 2017: 8
- Davidson, Robert: *'Transistor Radios Behind the Iron Curtain'* RadioUser, May 2018: 24
- Hackaday: Oleg Losev: **https://tinyurl.com/y6cghy6a**
- History of the Transistor (San José State University): **https://tinyurl.com/yahuhf7o**
- Transistor Timeline (Frenzel): **https://tinyurl.com/yc73d8kp**

computers. However, writing briefly about this journey masks the knowledge, skill and perseverance that each stage required.

I am a fervent admirer of those involved in the journey and I hope I have given some idea of the true wonder of the transistor to inspire further reading on the subject.

An excellent timeline of electrical and electronic engineering can be found at this URL: **https://tinyurl.com/y8osd3sg**

The textbox on the preceding page explains the workings of a junction transistor.

12

Evans, G. (2016) *The Transistor* (Redwoods Publishing)
ISBN 978-0-9547455-5-4
www.redwoodspublishing.com

[Geoffrey Evans was an electronic systems engineer and project manager with Murphy Radio, British Aerospace, Plessey, and Elliott Automation; His recent book, The Transistor *(Fig. 12) has been reviewed in* RadioUser, *October 2020: 14 -* ***Ed****.].*

LAMCO: New Vine Antennas 'AS' Range

Joe at LAMCO has been in touch to introduce the firm's new 'AS' range of aerials for our Vine Antenna brand. The AS-OCF-404-HP model, Joe thinks, will be the hot seller amongst them (see pictures). This innovative new aerial is designed to work brilliantly with an IC-7300, or with the new FT-DX10.

LAMCO also stock the following ranges of Vine Antennas:

The AS-CITY Range:
https://tinyurl.com/y63mdx7h
The AS-CITY-HP Range:
https://tinyurl.com/y69rad3w
The AS-CW Range:
https://tinyurl.com/y5h8qdt2
The AS-CW-HP Range:
https://tinyurl.com/yycyswtt
The AS-Urban-Portable-33 Kit:
https://tinyurl.com/y6355y2e
The AS-OCF Range:
https://tinyurl.com/y57be6m3

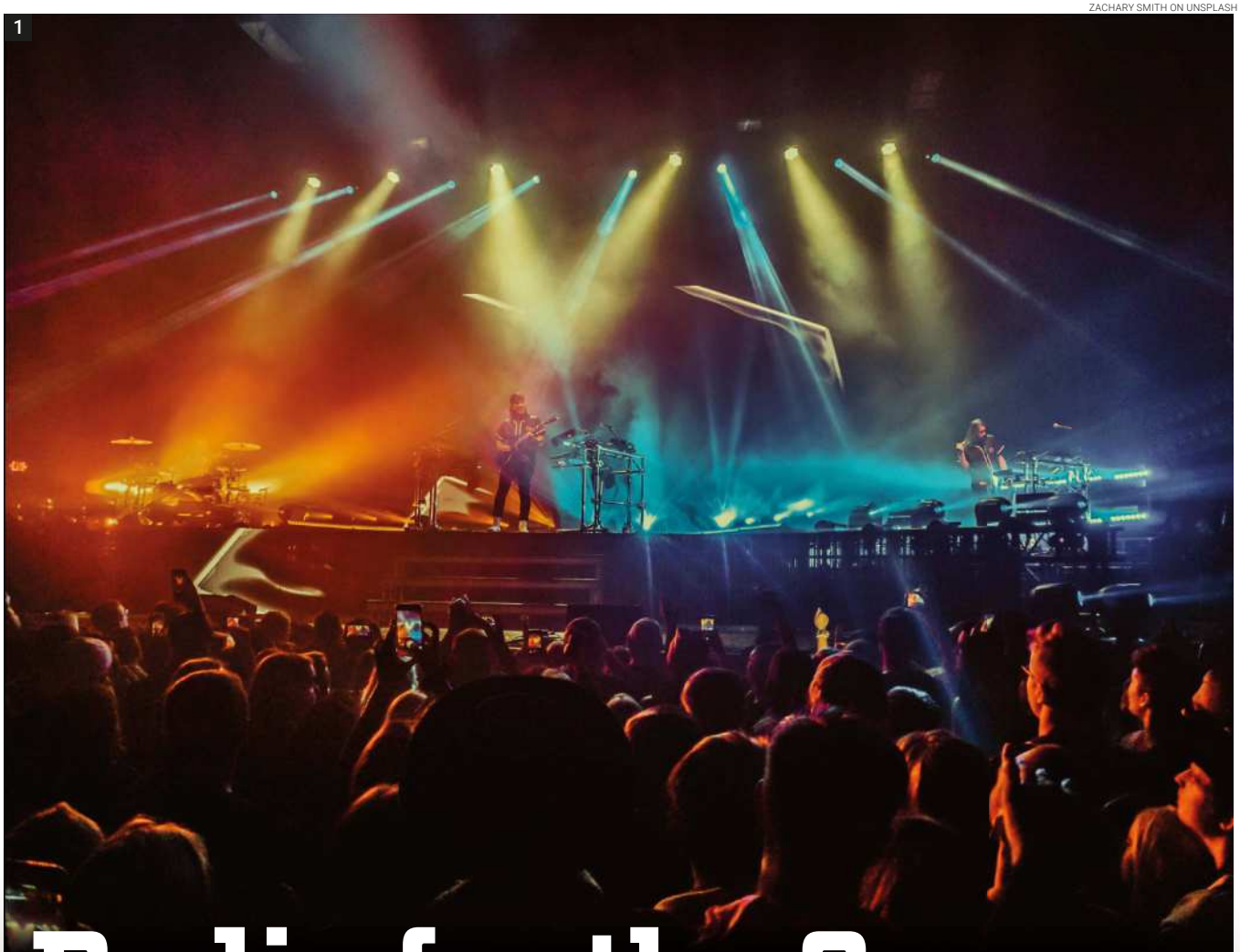
All antennas ranges come in 80m and 40m versions. Pictures on this page are of the AS-OCF-404-HP, the AS-Urban-Portable-33 Kit, and the AS-HF-OCF-80.

sales@hamradioshop.co.uk

LIGHT-BENDING SUN AND ELECTROMAGNETIC ENERGY: In one of the most famous scientific experiments of the 20th century, Sir Arthur Eddington and others carefully watched the solar eclipse of 29 May 1919. Eddington found that the positions of stars that appeared near the eclipsed Sun seemed to have shifted by a tiny amount. The shifts were consistent with predictions from Albert Einstein's theory of general relativity, which showed that a massive object warps the space around it and deflects passing light. In a new study, Fokkema and van den Berg suggest that gravity isn't the only reason light deflects around the Sun or other massive objects. Such objects also refract passing electromagnetic energy, with the amount of refraction dependent on the frequency of the signal. The researchers compared the propagation of electromagnetic energy using standard ray theory and a new approach based on the theory of geodesics. In the ray model, they say, rays of electromagnetic energy passing near and moving around the Sun or other massive bodies create a 'shadow zone'. As a result, *"the common straight rays of the standard approach cannot image the curvature of the boundary of an object,"* Fokkema wrote. In modelling the Sun, the researchers also included a third refractive component introduced by the corona. The combination shows good agreement with historical measurements of actual deflection around the Sun, the researchers say, particularly those made with radio interferometry, which provides the highest-resolution imaging of sources behind the Sun. *"We have concluded that these three contributions are essential to explain the deflection along the Sun and other stars,"* Fokkema wrote [...]. Read the full version of this fascinating piece here:
(SOURCE: Benningfield, D. (2020), *'A Better Understanding of how the Sun Bends Light'*, Eos, 101, 2020)
https://tinyurl.com/y9sbb7sq

JERSEY-BASED GB7JI JOINS THE D-STAR REPEATER NETWORK: The Jersey Amateur Radio Repeater Group has recently set up a new D-STAR repeater based in Jersey, just north of St Helier. The D-STAR repeater will mainly serve Jersey but should also provide coverage for the Channel Islands and adjacent French coast. GB7JI D-STAR Repeater is connected to the gateway and the internet. Details of GB7JI are as follows: Height 88m above sea level; TX Freq 430.850; RX Freq 438.450.
(SOURCE: ICOM UK; GJ8PVL).

ZACHARY SMITH ON UNSPLASH


1

Radio for the Senses

Chrissy Brand
chrissyLB@hotmail.co.uk

Chrissy Brand reports on a radio station in a shipping container, while a correspondent monitors short wave for developments in Tigray. On top of that, there are some culinary podcasts and radio programmes to savour.

It is fair to say that, whatever subject you are interested in, no matter how niche, weird or wonderful, there will be many radio programmes, podcasts and concert videos about it (e.g. Fig. 1). This is a reassuring fact for all of us.

However, on the flip side, concentrating your listening on areas you already know about, or are driven by, may result in a somewhat narrower world view.

A Lot of Radio

Bearing this in mind I want to share some joyous radio moments when I have tuned to a station or a stream quite by chance. This was the case for when, thanks to the Radio Garden app, I found myself listening to *The Lot Radio* one weekend. The station is located in Brooklyn, New York and I enjoy its clashing genres and independent sounds. The varied programmes all epitomise the ingenuity required to run a not-for-profit, live streaming, radio station.

It does not veer from its down to earth roots and musical integrity, based as it is in a reclaimed shipping container on an empty lot in New York City (Fig. 2). Hopefully, we can soon return to nights out in Manhattan, with radio stations like these as a soundtrack to the city that never sleeps.

www.thelotradio.com
http://weirdscienceny.com

Radio Worldwide

Radio Ukraine International produces programmes in English. *Ukrainian Diary* and *Sports and Fun* are among those, while *Insight* is a Monday programme looking at the country's geography, spiritual and

Fig. 1: Absolute Radio is heavily-driven by rock and pop guitar music of the kind offered at gigs like this one. Fig. 2: Brooklyn NY, where radio can even come out of a shipping container.

An episode of *Reading Lounge* that sticks in my head contained a poem called *Moses*, written in 1905 by Ivan Franco, which was very atmospheric, including the line, *"The sun was rolling up a mountainside as if a crimson wheel."*

Radio Ukraine International can be heard at its website, and daily at 1500 UTC at the *Radio Ben* portal.

www.nrcu.gov.ua/en
http://radioben.co.uk

Transatlantic DX is, of course, a two-way path. In the UK and the rest of Europe, we are used to logging North American medium wave stations, although it is always a thrill. I have always been intrigued to know what is being heard from Europe and Africa on the western side of the pond.

From London in Ontario, Canada, Paul Snider heard his first transatlantic DX of the season in late November, logging Radio Algérienne La Chaîne 1 at 0250 UTC on 891kHz. He used an Elad FDM-S2, Wellbrook ALA 1530 LN loop It was reported on the DXing Info Facebook page, that only discusses medium wave radio. Check out the main DXing Info website for all other forms of DX, including the mind-blowing Lapland DXpeditions.

https://tinyurl.com/y34kmbw8
www.dxing.info

Lionel Clyne reported that, as a result of the escalating crisis between the Ethiopian government and the *Tigray People's Liberation Front*, he decided to evaluate, as far as possible, the effect that this may have had on shortwave broadcasting in that region. According to *The Guardian* (November 18th, 2020), most communications were affected. However, there were no specific references to shortwave radio on this occasion.

Moreover, on November 17th and 18th, Lionel tried to log the following stations, on frequencies and at times that he usually hears them, but in vain: Voice of the Tigray Revolution, on 5950kHz at 1555 and 1905 UTC; Voice of the Broad Masses of Eritrea, on 7140 and 7180kHz at 1400 UTC; Radio Oromiya on 6030kHz at 1951 UTC; Radio Amhara on 6090kHz at 1028 UTC; and Radio Ethiopia on 7235kHz at 1409 UTC (Fig.1). However, he was able to log Radio Asmara on 7180kHz at 1419 UTC. broadcasting in Arabic from Selea, with a SINPO of 35222.

ANDRE BENZ ON UNSPLASH

2

Later in the month, Lionel performed a follow-up on his 'no logs log', given the worsening situation in Tigray, which is located in the northernmost region of Ethiopia. As Tigray became the centre of the storm, he thought it would be most fruitful to try to log *The Voice of The Tigray Revolution*. This station was scheduled to commence broadcasting at 5950kHz on 1500 UTC. However, the station he heard was difficult to identify but was certainly not WRMI in English, the only other station scheduled on that frequency at the time.

UK Calling

The Ampshire Podcast comes from Hampshire and is all about guitar bands (amps and Hampshire, see what they did there?). It consists of interviews with musicians, explaining how they write songs and, of course, examples of their music.

https://tinyurl.com/AmpshirePod

I often slate UK commercial radio for its lack of adventure and for regurgitating force-fed, past hits in "Guess the Year" features, but I sometimes tune into Absolute Radio.

With an identification slogan of "*Real Music Matters*", Absolute is in a similar vein to the *Ampshire Podcast*, but with vastly more resources, and therefore bigger audiences. It is a mainstream, guitar music-driven radio station (Fig. 1). I listen periodically, on medium wave.

The *No Repeat Guarantee* afternoon shows are presented by Leona Graham

Date	Time (UTC)	Station	Programme	Podcast	URL/ Stream/ Frequency
Weekdays	0500 to 1200UTC	Moose FM, Ontario, Canada	Moose Middays with Jess	https://tinyurl.com/y28jktnv	www.mynorthbaynow.com/moose-fm and 106.3MHz (in North Bay, Ontario!)
Monday	1200 to 1240	SABC Channel Africa, S Africa	Live Well (healthy, holistic African living)	https://tinyurl.com/SABCLiveWell	https://tinyurl.com/y4f2bsau and Intselsat 20 PAS 10
Tuesday	0806 to 0830 2306 to 2330	BBC World Service	People Fixing the World	https://tinyurl.com/yxflsgqq	https://tinyurl.com/y4nydcye and DAB, short wave
Wednesday	1700 to 1900	Fiesta FM, Southampton	Rock Your World with Okpar	Only live listening is available	https://tinyurl.com/y2lk9w4w and 95.0 MHz https://tinyurl.com/y2pcw368
Sunday	1800 to 1845	RTE Radio One, Dublin	Documentary on One	Apps plus https://tinyurl.com/y3pfurze	https://tinyurl.com/y66fvcr3 and 252kHz
Sunday	2000 to 2200	BBC Radio Manchester	Black news and music with Karen Gabay	BBC Sounds app	www.bbc.co.uk/programmes/p001d72h and DAB, 95.1 MHz

Table 1. My top listening recommendations for the month ahead in international radio.

and Ben Burrell. Ben's "best three opening tracks on an album" feature spawns much debate on the station's Twitter feed. Another plus for the station is its juxtaposing of complementary music.

I heard a blast from 1968, *Crosstown Traffic* by Jimi Hendrix, followed by *Little Talks*. This was the first single (in 2011) by Icelandic indie-folk band, Of Monsters and Men, who specialise in folkloric tales of nature, as well as contemporary issues. A classic 1997 song by Stereophonics, *A Thousand Trees*, rounded off a nice segment, illustrating the power of music radio and how it can create an atmosphere with a combination of unrelated artistes.

Ben Burrell appeared on a new music podcast, *Left of the Dial,* which sees Chris Attaway, *"climb inside the wardrobe, call some people, and ask them what they've been listening to lately."*

https://tinyurl.com/LeftDial

There is, of course, a large canon of rock music for any station to draw on, with this ever-popular genre now being in its seventh decade.

For breaking bands and new music, Absolute Radio 20s (New Music Matters) is an offshoot station available on a smart speaker near you.

I was also impressed with the Absolute 40s station last year, which looked back at World War II. Four, one-hour long, episodes are available online.

https://tinyurl.com/u9jnu5a
https://tinyurl.com/y2dy7346

A Feast of Listening

It is time now for a look at some radio programmes and podcasts on the topic of food. As you might expect, the vast US radio scene offers many food and cookery programmes. NPR's wonderful programme *Life Kit*: *Tools to Help You Get it Together* goes well beyond food and is a valuable guide to all manner of other 'everyday-hurdles' we face. It has covered finances, sleep, parenting, work and many other areas.

www.npr.org/lifekit

Radio Taiwan International airs *Feast Meets West*, on Saturdays at 1635 UTC on 6185kHz, and at the station website. The programme blurb evokes an enticing atmosphere that made me want to tune in, "*Truly Taiwanese fragrances and flavors that waft from restaurants and apartment kitchens at dusk every night. Stewed food, stinky tofu, even the simplest of homemade dumplings are enough to conjure up memories among overseas Taiwanese longing for the flavors of home. Pull up a chair and join hosts Andrew Ryan and Ellen Chu for their weekly dinner date. Each episode features a menu filled with wonderful foods, people, and topics related to food culture in Taiwan.*"

https://tinyurl.com/y4wnuknx

On Mother Jones' *Bite*, writers, farmers, scientists and chefs uncover the stories behind what ends up on your plate.

www.motherjones.com/topics/bite

Radio New Zealand's *Healthy or Hoax* sees Stacey Morrison investigate the latest food and fitness trends. She has turned the spotlight on fasting, turmeric, and raw food.

https://tinyurl.com/y5dgd6sj

On PRN (Progressive Radio Network), join Bhavani at *iEat Green*, for vegetarian dinner and ways for your family to live a more sustainable life. Due to Covid-19, 2020 was the first year for a quarter of a century where Bhavani was unable to cook a Thanksgiving feast for the homeless.

www.ieatgreen.com

It was news to me, but *Food & Wine with Chef Jamie Gwen* is, "*the most adored and followed culinary talk show on the radio.*" Radio station KABC 790 in Los Angeles is the place to find her.

https://tinyurl.com/y3uxa4yk

Malcolm White on *Deep South Dining* talks about secret sauces, speciality-dishes and the history of southern US cooking. It is a weekly programme, with more than mere food, on Mississippi Public Broadcasting's Think Radio.

http://deepsouthdining.mpbonline.org

From the UK, three programmes jump out at me. *The Foodie* is on BBC Radio Ulster and sees Kim Lenaghan travel around Northern Ireland meeting people with a passion for food. There are six series for you to catch up with.

www.bbc.co.uk/programmes/b06gwfgs

BBC World Service's *The Food Chain* investigates the, "*business, science and cultural significance of food, and what it takes to put food on your plate*". It is on the air on Thursdays at 0932, 1332 and 2332 UTC, and available as a podcast.

BBC Radio 4's *The Kitchen Cabinet* is hosted by food critic Jay Rayner. Pre-pandemic, the show was recorded with an audience at a UK different location each week, *"to dig into their culinary quirks."*

The most recent series has been recorded online. I was fortunate to join the audience for one of the recordings.

Panellists and the audience talk about food history and famous dishes, giving the perspectives of chefs, food writers, culinary scientists and psychologists.

www.bbc.co.uk/programmes/b01klvhq

The Monocle's guide to the world of food, drink and entertainment is called *The Menu*. Listen to the world's most creative chefs, and discover new ingredients.

https://tinyurl.com/y9ex649p

Table 1 offers my listening hints and tips for this month.

Good Listening.

UK Airband Frequency Guide (UKAFG) 2021

Georg Wiessala
wiessala@hotmail.com

The editor takes a closer look at the 2021 version of UKAFG, the United Kingdom Airband Frequency Guide, compiled by Rick King.

Airband listening and monitoring remain very popular branches of the radio hobby; the monthly *Airband News* column in this magazine, and the many responses its author, David Smith, receives from readers throughout the year bear testimony to that. There are several online frequency guides available, nationwide or organised by particular UK regions, counties or airports, and you will also find some relevant Facebook groups and spotting fora on the internet. These can be prone to two kinds of problems; unreliable information and outdated frequencies, both of which are the *bête noire* of the airband listening enthusiast.

There is, therefore, a market for well-researched paper-based frequency and airport information, and Rick King has been providing this for some time now. The 2021 edition of his UK Airband Frequency Guide (UKAFG) has just landed on my desk. As airband listening, with my old and new receivers, is a major pastime for me here in the North West of the UK, I thought I'd have another look at this publication.

The easy-to-read, spiral-bound book usefully includes access to specific website content until 1st January 2022, if you have purchased your copy from the UKAFG website (below). This will afford you access to frequency updates, interactive maps, civil and military callsigns, and other data.

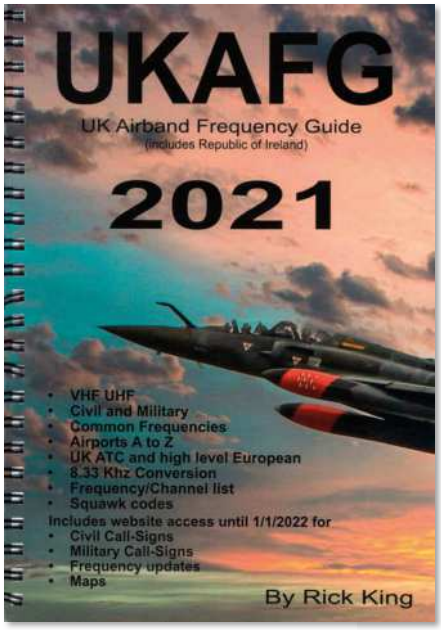
The 2021 UKAFG makes this, and more, available utilizing QR codes, which you can scan with your smartphone and a QR code reader app, of which there are as many as aircraft in the sky.

To register, you will find a unique registration code in the front of the book.

Each chapter of the main text is also prefaced by a QR code, taking you to interactive maps, updated frequency lists and supplementary information on the UKAFG website. Very neat.

The book offers sections on UK civil and military ATC, European ATC, common frequencies, an A-Z or civil and military airports, and airports by region.

Furthermore, there are frequency and channel search lists, air display teams' frequencies, a frequency/channel conversion list, squawk codes, acronyms, and room for notes – useful when out and about.



UKAFG UK Airband Frequency Guide
by King, Rick (2020)
Spiral-bound, 124pp.
www.ukafg.co.uk
www.facebook.com/groups/UKAFGS

While the 2020 edition of this title comprised of 214 pages, this year's edition has shrunk considerably, to just 124, a reduction of 90 pages.

The table of contents (index) is now half a page long and does not list individual airports any more.

Overall, it appears that the information here has been efficiently restructured and re-organised, with civil and military airports now separated out, common frequencies drawn up-front, and the conversion table streamlined from eight pages to two, using a clever conversion method and pointing the reader to an online automatic 8.33MHz converter, once again via a QR code.

This – together with the tidying up of superfluous empty lines between airports and other spaces – as well as a slight text-size reduction has made the book more streamlined and cleaned-up.

The squawk codes list has expanded, but, sadly, the information on HF airband – including VOLMET – has disappeared. This is as a result of a 2,000-person poll the author conducted, and in which there was little interest in including HF Airband.

The method of moving out significant parts of the guide to online sources is innovative, and it opens up new resources, but it might disappoint some, who would like to monitor without computers and smartphones, maybe whilst on the road or at an airshow (remember those?)

The list of airband-related acronyms and abbreviations is longer than last year's.

That notwithstanding, it is not nearly long enough, and it would have been useful to include a much more expansive list here, with explanations of technical terms, frequently-heard airband-jargon and related information used on/in the air.

This would, I feel, help airband listeners to understand what exactly is being said on their radio, and which technical matters and processes are referred to in aeronautical voice communications.

Overall, the key information in this year's UKAFG is clearly presented, utterly reliable and very useful to anyone with an interest in 'listening to the birds'. It is in the supplementary areas, on top of the listing of the key frequencies, that, in my view, a major commercial advantage of this book might lie. There is certainly some room for expansion here; but overall, this title has a great future in the hobby community.

"Overall, the key information in this year's UKAFG is clearly presented, utterly reliable and very useful to anyone with an interest in listening to the birds"

The Golden Globe Race & a Short History of the Consol System

Robert Connolly
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Robert Connolly passes on a request for information from a participant of the 2022 Golden Globe Race and takes a look at the very early history of hyperbolic radio navigation, especially the Sonne/Consol system.

COURTESY OF MALCOM WILSON.

1

This month, I am beginning with an appeal for help. Reader Ian Herbert-Jones has contacted me seeking some information: Ian tells me that he is taking part in the next *Golden Globe* race in 2022. The *Golden Globe* race departs Les Sables-d'Olonne, France, on Sunday 4 September 2022. Participants sail solo, non-stop, around the world, via the five Great Capes and return to Les Sables-d'Olonne.

This involves sailing solo for 30,000 miles non-stop, without any outside assistance. The race celebrates Sir Robin Knox-Johnston's historic 1968/9 world first solo non-stop circumnavigation in the *Sunday Times Golden Globe Yacht Race* (cf Knox-Johnston, 2018).

However, this contest is very different from any other round-the-world yacht race.

The total number of entrants is limited to 35, made up of 23, plus 5 who have been specially invited in the *Suhaila* class, and up to seven in the *Joshua* class. These yachts are heavily built, strong and sturdy, similar in concept to Sir Robin's 32ft vessel *Suhaili*.

Entrants are limited to sailing similar yachts and equipment to what was available to Sir Robin in that first race. That means sailing without modern technology or the benefit of satellite-based navigation aids. Competitors must sail in production boats between 32ft and 36ft overall (9.75 – 10.97m) designed before 1988 that have a full-length keel with rudder attached to their trailing edge. To enter, sailors will require to have completed at least 4,000 ocean sailing miles before applying for an invitation to compete. An extra 1,000-mile non-stop solo qualifying voyage in the GGR-entered yacht, using only celestial navigation is required on top of the previous minimum 8,000 ocean miles and a further 2,000 solo miles.

The event is an eastward circumnavigation, and competitors will sail down the Atlantic from North to South, across the Southern Ocean, around Cape Horn and up the Atlantic from south to north returning to the finish.

It is anticipated that the winner will complete the voyage in around 250 days. Sir Robin Knox-Johnston's round the world voyage took 312 days at sea.

Entrants may seek shelter and anchor (using the engine if needed) to make repairs but may not enter a port, and no person may give any material assistance at any time during the Race. At the end of the race, the ships' logs and celestial navigation notes will be scrutinized for compliance; further declarations have to be signed by the entrant, confirming rule compliance during the Race.

They will be navigating with sextant on paper charts, without electronic instruments or autopilots. They will hand-write their logs and determine the weather for themselves. Only occasionally will they talk to loved ones and the outside world when and where long-range high-frequency radios allow.

The following are typical things that are NOT allowed to be carried on the boat; GPS, radar, chart plotters and electronic charts, electronic wind instruments, electronic log, mobile phone, iPhone, iPod, Kindle or any computer-based device, CD players, electronic watches/clocks, video cameras and electronic cameras, electronics of any kind, satellite equipment of any kind, digital binoculars, pocket calculators, water-maker, carbon fibre, spectra, any high-tech materials, and so on.

Each entrant will be supplied a standard race pack by the event's organisers. The technology may change, but it will include – but not be limited to – a stand-alone satellite tracking system (the skippers cannot see) for web tracking updates, a two-way satellite short text paging unit (to race headquarters only) for twice-daily 100-character text reports, two hand-held satellite phones (for important calls to Race HQ only) for a once-a-week safety check-in only, a sealed box with a portable GPS chart plotter (for emergency use only).

All Entrants will be tracked 24/7 by satellite, but competitors will not be able to interrogate this information unless an emergency arises, and they break open their sealed safety box containing a GPS

Fig. 1: The Bushmills Consol station. Fig. 2: The Exterior and masts of the Bushmills site. Fig. 3: The Bushmills Rotating Goniometer. Fig. 4: When the mast came down. Fig. 5: *AGARdograph 63* (Bauss). Fig. 6: Bushmills plaque. Fig. 7: A Consol signal. Fig. 8: Jim Bennett's 2017 title is a great introduction to the overall history of navigation.

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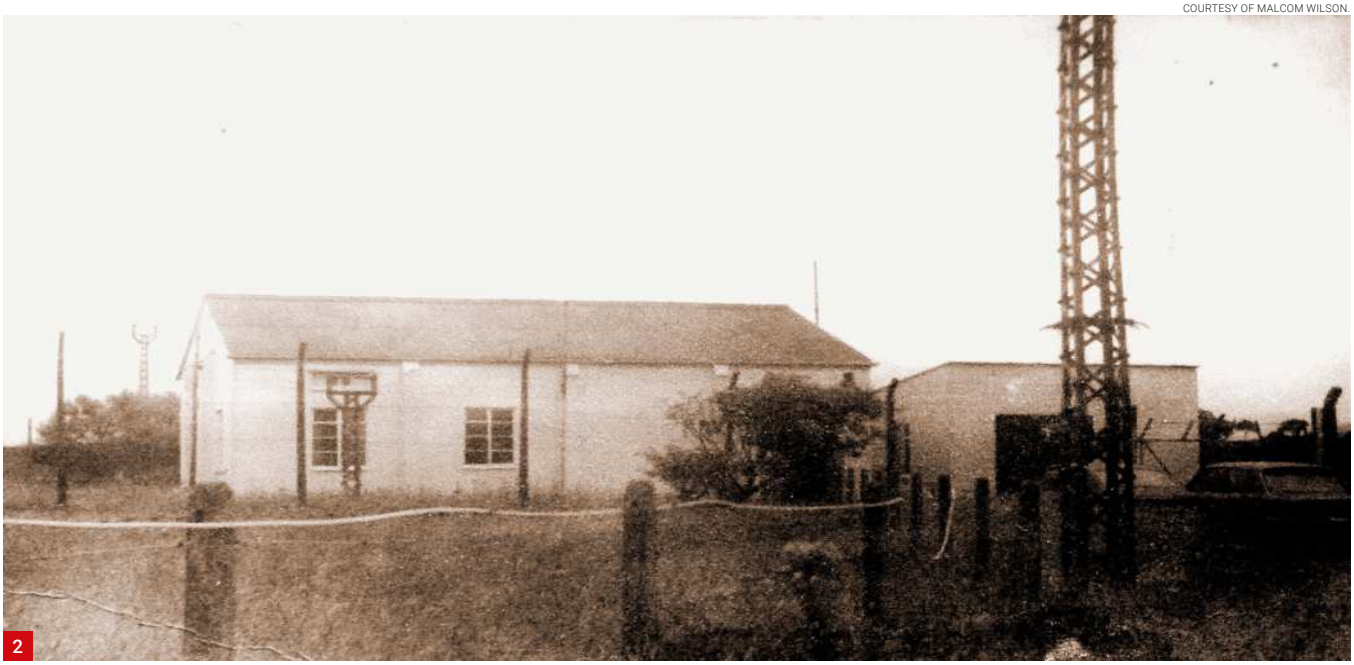

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and satellite phone. Doing this, however, has consequences.

By breaking the seal, competitors will be deemed to have retired from the Golden Globe Race, and instead will be relegated to the *Chichester Class* as if they had made a stop.

A Call for Information

Against this background, Ian has asked me for two areas of assistance: first, finding a good working hand-held radio direction finder that dates from around the period of Sir Robin Knox-Johnston's 1968/9. This must be sensitive enough to receive Non-Directional Beacons (NDBs) at long range; for example, a *Lokata* 7 or similar.

The other area of assistance Ian is looking for is someone who offers training, using an SSB 101 transceiver. If you can help in any way, please let me have your contact details and I will pass them on to Ian.

I hope to be able to keep readers up to date with Ian's progress for this race via this column.

The Consol Navigation System

In my June 2015 column (*RadioUser*, June 2015: 34), I provided an insight into the old *Consol* hyperbolic navigation system. The term 'hyperbolic' derives from the overlaid lines on special charts in use with this kind of system (Bennett, 2017: 103), and *Consol* was one of several long-range navigations systems used by aircraft and ships before satellite navigation came about.

The *Consol* system was based on the *Sonne* (German for 'Sun') navigation technology, which had been developed by Germany for navigation of its aircraft and U -boats during World War 2. The *Sonne* system, in turn, was a development of an earlier system called *Elektra*. This was an updated version of the beam-based low-frequency radio range (LFR) used in the United States during the 1930s.

The *Sonne* setup used three separate fixed antennas, spread along a line, with each antenna 1 km from the next – a distance of three wavelengths at the 300kHz operational frequency (several frequencies were used between 250–350 kHz). A single transmitter produced a signal that was sent directly to the centre antenna. The signal was also split off from the main feed and sent to a keying unit. This further split the signal into one of two paths, each connected to one of the two side antennas.

The keying unit sent the signal briefly to one antenna, then – for a longer duration – to the second one, producing the dot-dash pattern used in the *Lorenz* systems. The transmission sequence is composed of the navigational (keying) cycle (a combination of 60 dot and dash characters), a long dash, the identification signal and a short interval. Some American stations used a slightly modified version with only two antennas but employing the same method as *Consol* for keying. Officially this system was called *Consolan*, but in essence, this was identical to the normal Consol transmitters.

Consol Apparatus

Each Consol ground station consisted of a transmitter and three aerials in a straight

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3

line. Using this aid to navigation required nothing more than a suitable receiver and a set either of special charts or tables. The document CAP 59 was the UK handbook, which included the tables; it stated that (with various caveats) ranges by day over the sea were around 1,000 nm (and by night 1200 nm), with an accuracy of +/-0.5 degree.

However, using *Consol* was a slow process - you could not take simultaneous fixes, and each plot required about two minutes of concentrated effort, as I learned when I was experimenting one night with the signal from Europe's last *Consol* station, Stavanger in Norway, transmitting LEC on 319kHz before it closed in 1991.

That station is now an aeronautical NDB, operating at much lower power and transmitting with the callsign VAR on that

frequency. The output of *Consol* stations was between 1.5 and 5kW, depending on location.

There was only one *Consol* station in the UK, located at Bushmills, Co. Antrim, Northern Ireland (Fig. 1).

It was installed by the RAF at the end of World War II. In January 1947, it was transferred to the Ministry of Civil Aviation, to be maintained by National Air Traffic Service (NATS) telecommunications engineers based and *Belfast Nutts Corner* airport – later *Belfast Aldergrove* when the civil airport moved to that location.

The Bushmills station used three 325-feet masts (Fig. 2), separated by 3 λ, with a rotating goniometer (Fig. 3), which was phase-shifting the outer antenna signals by +/- 90 degrees over a minute, including the transmission of its callsign MWN, in Morse Code on 266kHz *(A goniometer is an instrument that either measures an angle or allows an object to be rotated to a precise angular position - Ed.)*.

The transmitter used was a Type T14I2, with an output power of 2kW. Drive for the power amplifier stage was a crystal-controlled oscillator between 150 and 1,200kHz, according to the information submitted by the UK to a *1955 ICAO Report on Consol Navigation*.

https://www.icao.int/Pages/default.aspx

Historical Hindsight

In my 2015 column, I mentioned that the station was blown up by a terrorist bomb. This was probably because it was in the early days of the Northern Ireland "*Troubles*" when terrorist bombs were going off left, right and centre. When one of our engineers at the time told us that the Bushmills mast had been blown up the previous evening, it was natural for me to assume it was terror-related, as I was not previously aware of the planned closure of the station.

Recently I discovered that this was incorrect. While it was blown up, this was, in fact, a controlled explosion in September 1976, carried out by members of the *64th Royal Engineers Amphibious Squadron* who were stationed in Antrim (Fig. 4). The demolition crew were using three one-pound plastic explosive cutting charges to sever the guy lines.

The station was closed by the Ministry of Civil Aviation due to the increasing costs involved in maintaining it. The evening before its closure was marked by a special farewell celebration, to which many people involved with *Consol* were invited to attend. The Senior Telecommunications Officer was a radio amateur, and a special event amateur radio station went on the air as part of the closure. The control unit of the station and other memorabilia (Fig. 6) were retained after closure and are now on display at the *Ulster Aviation Society Museum* as part of the *Fred Jennings Radio Room*.

www.ulsteraviationsociety.org/home

Table 1 is an updated list of known active *Consol* stations. It should be noted that LEX Andøya, LJS Bjørnøya, and LMC Jan Mayen all transmitted on 332.5kHz in turns over a four-minute cycle. Additional *Consol* stations were planned as follows: St. John's, NL, Canada; Nanortalik, Greenland; Eyrarbakki, Iceland; Cape Hatteras, NC, USA, (planned frequency 198kHz); Point Conception, CA, USA; Pescadero, CA, USA, callsign PES, frequency 190kHz (first built as a homing beacon but was never converted to a Consol station as planned); and Santa Maria, Azores, Portugal call sign SMA, frequency 323kHz (repurposed homing beacon, but was never converted to a Consol station as planned).

Atlantic City, NJ, USA, call sign ATA, was a test station using 526kHz; however, it was shut down after a short period of operation due to frequency assignment issues. You will also see that some stations had their frequency or callsign changed during their operational life.

Table 2 shows the transmission characteristics of stations that were operational in early 1961, as detailed in *AGARDograph 63, Radio Navigation*

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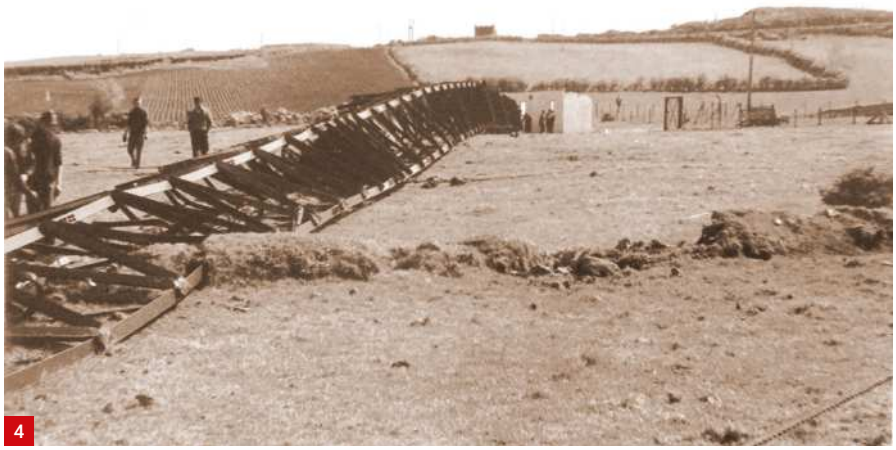

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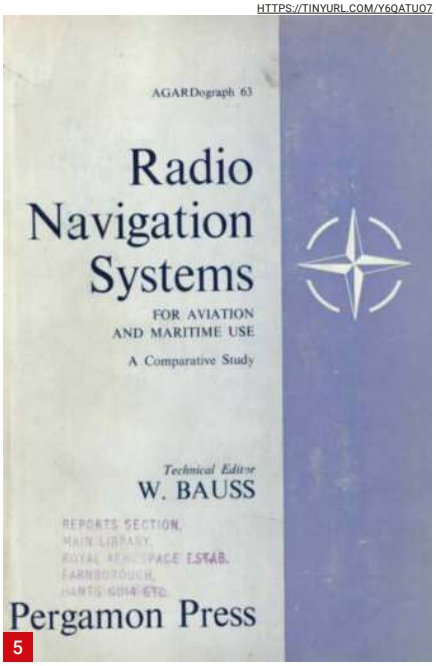
Call Sign	Freq (kHz)	Station	Country	Position	Built / Closed
TRQ ~	257.0	Ploneis	France	48°01'16"N 04°12'54"W	1946 / ?
MWN #	266.0	Bushmills	Northern Ireland	55°12'20"N 06°28'02"W	1946 closed 1971
LG *	285.0	Lugo	Northern Spain	43°14'53"N 07°28'55"W	1940
SL **	315.0	Seville	Southern Spain	37°31' 17"N 06° 01'48"W	1940
LEC	319.0	Stavanger	Norway	58°37'31"N 05°37'49"E	1940 replaced in 1971 closed 1991
LEX	332.5	Andøya	Norway	69°06'N 15°43'E (approx.)	1970 closed 1985
LJS	332.5	Bjørnøya	Norway	74°31'N 19°01'E (approx.)	1970 closed 1985
LMC	332.5	Jan Mayen	Jan Mayen	70°59'N 8°32'W (approx.)	1970 closed 1985
KN	269.0	Cape Kanin	Russia	68°38'18"N 43°23'30"E	1958 - 1960
RB	363.0	Rybacij	Russia	69°45'12"N 32°55'00"E	1958 - 1960
TUK	194.0	Nantucket	USA	41°16'58"N 70°5'58"W	1958
SFI	192.0	San Francisco	USA	37°47'N 122°25'W	1959

~ callsign later changed to FRQ. # Initial frequency: 263.0kHz. * Initial frequency: 303.0kHz. ** initial frequency: 311.0kHz.

Table 1: Known Consol Stations.

HTTPS://TINYURL.COM/Y6QATUO7



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Systems For Aviation and Maritime Use - A Comparative Study, written by technical editor W. Bauss (Fig. 5)
https://tinyurl.com/yy2docmq

Additional information regarding *Sonne/ Consol* may be found at these URLs:
www.jproc.ca/hyperbolic/consol.html
https://tinyurl.com/yxmbb5lu

A screenshot of a typical Consol signal can be seen in Fig. 7.

My sincere thanks for the additional information regarding the Bushmills station goes to Malcom Wilson. His father was the NATS Senior Telecommunications Officer at Belfast Aldergrove Airport who had responsibility for maintaining the station while it was operational.

The Bushmills Consol station was not the only long-range navigation station located in Northern Ireland. A *Decca* slave station was located close to the centre of the Provence on the southern edge of Lough Neagh near Craigavon. Sadly, it was also closed quite a few years ago as the final part of the complete closure of the *Decca* navigation system (2000).

I will provide more information on the Decca navigation system in a future column.

For those of you seeking a good introduction to the history of navigation – radio-based and otherwise – the title in Fig. 8 can be recommended.

Tables 2 and 3 point to the importance of international cooperation in matters of radio navigation and safety of life at sea and contain links to relevant multilateral bodies and resources.

Until next time, *Fair Winds*.

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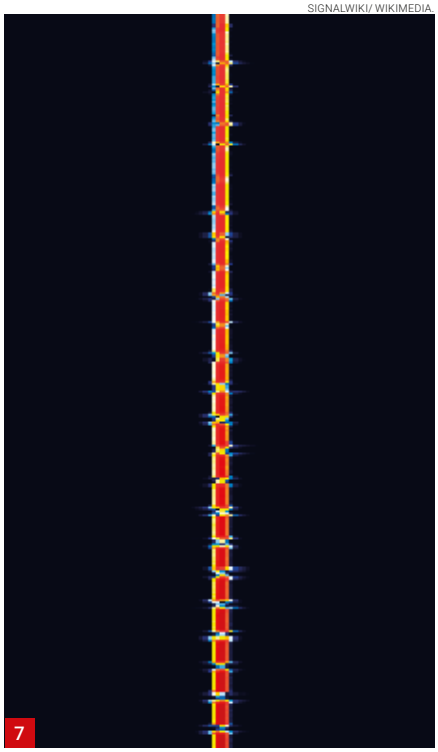
SIGNALWIKI/ WIKIMEDIA.



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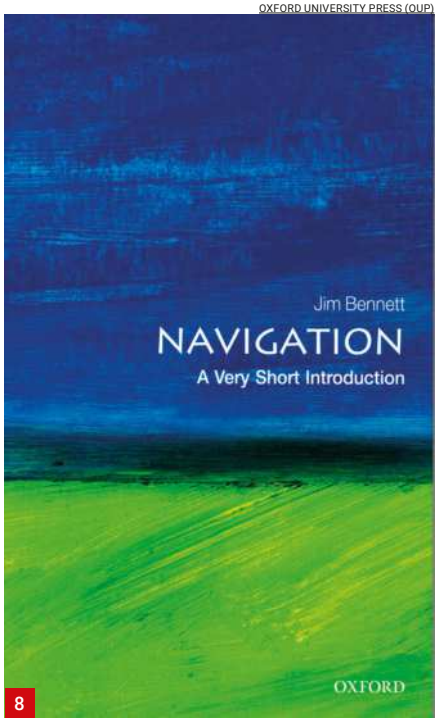

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- International Association of Institutes of Navigation (IAIN): **http://www.iainav.org/iain-about.html**
- International Association of Lighthouse Authorities (IALA): **https://www.iala-aism.org**
- International Association of Maritime Universities (IAMU): **https://tinyurl.com/ycplugtj**
- International Convention on Standards of Training, Certification and Watchkeeping (STCW): **https://tinyurl.com/y8sfnay3**
- International Hydrographic Organisation (IHO): **https://iho.int**
- International Maritime Organisation (IMO): **https://www.imo.org**
- International Meridian Conference (Washington, 1884): **https://tinyurl.com/yyrvaqu7**
- Maritime and Coastguard Agency: **https://tinyurl.com/qjuxuuv**
- Nautical Institute (NI): **https://www.nautinst.org**
- Safety of Life at Sea (SOLAS) Convention (1912): **https://tinyurl.com/y39tay88**
- US Naval Academy (USNA): **https://www.usna.edu/homepage.php**

Table 2: International Cooperation in Navigation and Radio (From: Bennett, 2020: 109ff.).

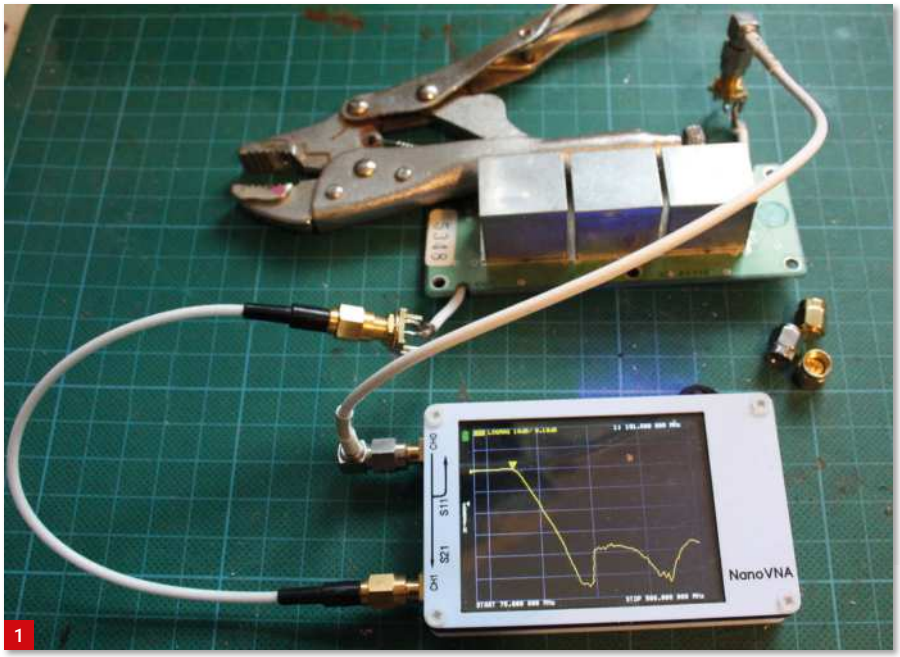
- Bennett, J. (2017) *Navigation – A Very Short Introduction* (Oxford: OUP, esp. Ch. 6)
- Consol (in German) **http://www.seefunknetz.de/consol.htm**
- History of ATC: **https://tinyurl.com/y6o38qkp** **https://tinyurl.com/y9hm8mcu**
- Knox-Johnston, R. (2018): *Knox-Johnston on Seamanship & Seafaring: Lessons & Experiences from the 50 Years Since the Start of His Record-Breaking Voyage* (Fernhurst Books Ltd.)
- Radio Navigation and Positioning: **https://tinyurl.com/yxjnvca5**
- Rankin, W. (2014) *'The Geography of Radionavigation and the Politics of Intangible Artifacts'* (Project Muse); Technology and Culture, 55, 3: 622-674 (Johns Hopkins UP); DOI: 10.1353/tech.2014.0077) **https://muse.jhu.edu/article/551608**
- Skybrary: **https://tinyurl.com/y4272n9l**
- Sonne/ Consol: **http://jproc.ca/hyperbolic/consol.html.**

Table 3: You can find some further information on the *Sonne/Consol* Systems here.

The NanoVNA Continued and Practical Modelling

Keith Rawlings
Keith.g4miu@gmail.com

Keith Rawlings continues his investigation of Vector Network Analysers and the Nano VNA, followed by a brief review of a new book on aerial modelling, which aims to inspire a broad range of radio enthusiasts.



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Last month, I described the NanoVNA and how to perform the calibration process. After I sent my copy in, I thought I should have pointed out that the calibration procedure I described is not the same as one might have with an oscilloscope, a signal generator or even a VNA itself, where instruments are periodically checked against a traceable standard, and this calibration is then valid for a certain period providing confidence in the set's performance.

By contrast, the calibration of a VNA I described is a 'user' or 'measurement' type of calibration, which mathematically removes the losses and delays caused by the likes of cables and connectors before the DUT itself is measured. It is worth remembering that there is no such thing as a 'true' measurement as there will always be some error, and that there is a difference between precision and accuracy.

Devices such as the Nano are capable of giving reasonably precise results. The accuracy will depend on several factors – with user calibration being one of them.

However, for the type of work enthusiasts will use the Nano for I would say don't get *too* hung up on this as in many cases there is not a need for extreme accuracy.

For those new to VNA's techniques used may seem *very* confusing. I suggest that on-line documentation for the Nano is read and some of the excellent YouTube videos watched along with this text.

Aerial SWR Measurement.

When undertaking a reading of Voltage Standing-Wave Ratio (VSWR) we use a single-port measurement so we only measure at Channel 0 S11/Reflection port. To get started, enter *Menu* and select *DISPLAY*, then *TRACE*. To de-clutter the display, disable unwanted traces by touching on them; for this example just leave TRACE 0 (Yellow) selected.

Now go back and Select *CHANNEL*, and *CH0 REFLECT*. This allocates TRACE 0 to CH0, the S11/Reflection channel. Go back and select *FORMAT* and then *SWR*.

We now need to determine the frequency span.

For the example here, I have selected a very wide span as I will measure an aeronautical blade aerial and attempt to demonstrate its wide-band characteristics (Fig. 2).

Substitute your frequency span accordingly.

For the blade, I selected *STIMULUS*, choose *START* and tap *'100M'* into the keypad. Then go to *STOP* and tap *'1000M'* (just to prove the Nano runs above 900MHz). This will give a 100-1000MHz span. You can, of course, select a narrower span. If you just need to cover the 2m band, you could tap '140M' and then '150M'.

Once set up, you can now calibrate at the end of our feeder line. Go to *CALIBRATE* and tap *RESET*. Then perform the Open-Short-Load calibration as described last month (*RadioUser*, January 2020: 53).

Tap *DONE* and save if you wish.

I used a Type-N calibration kit since the aerial to be measured is fitted with a Type-N socket.

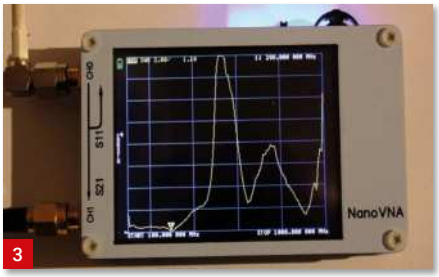
Connect your aerial and the Nano should now display on the Trace the SWR characteristics of the aerial over the swept range.

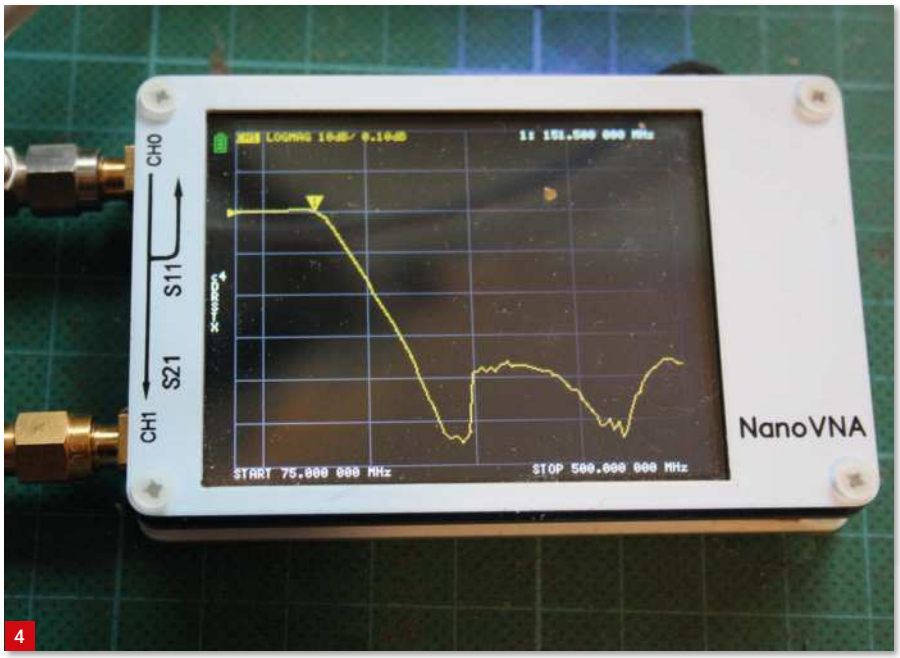
Going to *STIMULUS*, the sweep can be paused at any time by selecting *Pause Sweep*.

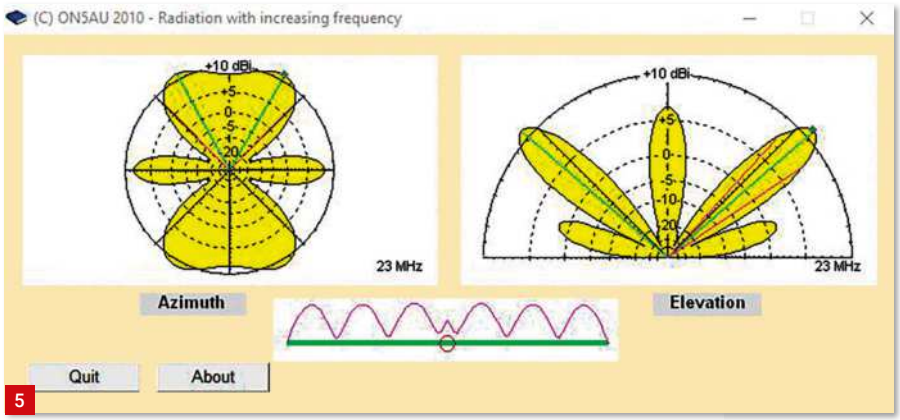
If the trace is not positioned on the screen as you would like it, you will have to navigate to *SCALE* and play around with *REFERENCE POSITION*. This places the trace baseline at a selected position on the screen; the parameter *SCALE/DIVision* changes the units per division.

The example shown in Fig. 3 ('SWR 2.00/1.10'), indicates that CH0 is set to read SWR at two units per division; here we have a reading at the marker of 1.1 at 298MHz, which is the actual SWR measured. The Reference Position is '0'.

As you can see from Fig. 3, the blade aerial has quite a wide bandwidth with a







Standing Wave Ratio (SWR) lower than 2:1 between 100 and 352MHz, only rising to 2.5:1 at 400MHz. There is a dip at 910MHz of 2.3:1. This may or may not be intentional.

Filter Measurement

Another useful measurement you can perform with the Nano relates to filters. In my next example, I have chosen to sweep a low-pass filter taken from a Kyodo KG110 base station repeater. This unit used to operate in the JRC band between 139.5-140.5 and 148-149MHz, so it should have a cut-off above 150MHz at least.

The filter would have been in position to attenuate harmonics from the transmitter.

This will be a two-port through-measurement using CH0 and CH1.

Using the same techniques as above select *Select CH1 as LOGMAG in any TRACE*.

A through-calibration is required as demonstrated last month (*RadioUser*, January 2020: 53).

You now need to set the span; for this filter, I set it as 75 to 500MHz.

Connect your filter, with CH0 going to the input and CH1 to the output. If all is well, for a low pass filter, you should get a trace similar to the one you can see in Fig. 4.

Here we can observe the through-response of the filter. Set to read 10dB per division, I have placed the marker just at the point where the filter starts to attenuate(0.1dB) at 151.5 MHz. Before this, the insertion loss was calculated as 0.03 dB, attenuation then starts to increase rapidly from this point on.

You can move the markers with the thumbwheel and read off the frequency and attenuation in dB on the screen.

The span has been set to cover up to the 6th Harmonic and it can be seen that, although the attenuation initially is quite high at about 55dB it then reduces to around 37dB.

Do not forget that you can also select CH0 SWR in one of the other traces to view the matching of the filter.

The image in Fig. 1 demonstrates the test setup.

For the beginner, I recommend undertaking measurements of known devices first to gain confidence. This is something also undertaken by experienced users as well and is often referred to as the 'Sanity Check', something I have had to do a few times!

[so does the editor, daily – Ed.].

Views of the NanoVNA

In conclusion, the Nano VNA is a valuable tool for the radio enthusiast. It will allow you to check and tune aerials and filters. Components such as capacitors and inductors may be measured at a frequency other than DC. Another feature that I am sure many readers will find useful is that of measuring cable loss. For instance, just how much signal is getting to your discone at the end of that run of cheap 75Ω TV coax?

The device provides a very affordable entry into the world of RF measurement. It is capable of giving surprisingly accurate results, which will be more than good enough for most radio hobbyists.

It is very compact; moreover, with its internal battery, it is ideally suited for making measurements just about anywhere. The screen is clear but small.

I found that operation of the touch screen display was easier using a stylus of the type ordinarily intended for mobile phones.

On the model I have here I found the thumb wheel a bit erratic and got frustrated

Fig. 1: My key LPF test set-up - mini mole grips were used to keep the filter in position for the photograph Fig. 2: The 'aircraft-blade' type of aerial I tested; Fig. 3: Blade aerial sweep, demonstrating a very low VSWR between 100-400MHz. Fig. 4: Key LPF sweep demonstrating the low insertion loss below the cut-off frequency. Fig. 5: The radiation-pattern 'wizard' demonstrating the change of radiation pattern with increasing frequency. Fig. 6: The book *Practical Antenna Models (Vol 1)* by Marcel De Canck, ON5AU.

with its use.

Being menu-driven there is a lot of stepping back and forth to select the different features of the device, understandably so, but it soon becomes second nature.

The model I used covers up to 900MHz. There are now models (V2) that will span 50kHz to 3GHz (and quoted as usable to over 4GHz). These are available for under £50 in the UK, which is incredible.

Yes, there are limitations, and it would not be fair to compare this kind of equipment with commercial models with prices in the five-figure range.

However, for the home workshop, the NanoVNA brings features that at one time were way out of reach of most people. All in all, it represents great value for money.

I will cover more basic measurements in the coming months. I have not discussed advanced matters such as calibration planes, port extensions, and the software that can be used with the Nano.

If there is interest I can cover the use of Software in the future. Just let me know.

https://tinyurl.com/yc7qex27

I have found an IO group for the NanoVNA which I found when looking for something else. It seems to have a great deal of info on it and specifically this beginners guide.

https://tinyurl.com/y6w8z8np
https://groups.io/g/nanovna-users

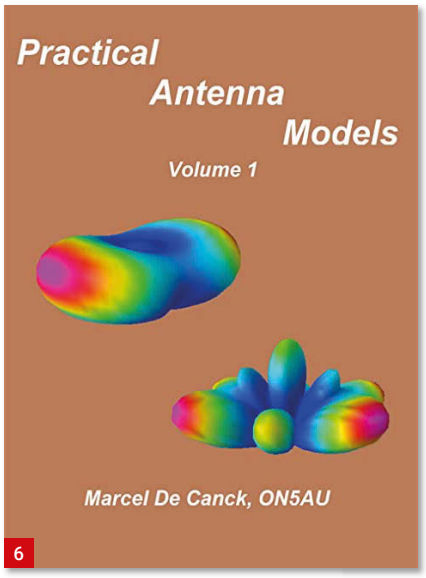
An Interesting Link

It seems the Pros are beginning to realise what amateurs have always known, HF is not dead!

https://tinyurl.com/yb95xo7w

With that, please stay safe, and I will see you all next month!

ALL PICTURES: KEITH RAWLINGS



Practical Antenna Models, Vol. 1
De Canck, Marcel ON5AU (2020)
220 pp.; pbk (independently published)
ISBN-13: 979-8676497941.

Advanced Antenna Modeling
(De Canck, Marcel ON5AU [2019]
584 pp.; Amazon KDP).

In the January 2021 edition of *Practical Wireless*, I reviewed the book *Advanced Antenna Modeling,* by Marcel De Canck ON5AU. Although it is described as 'advanced', I found the book was entirely suitable for the beginner to aerial modelling.

Marcel has now published a further book titled *Practical Antenna Models, Volume One*. Its content is taken from the series of columns that Marcel wrote for the *AntenneX* online magazine between 2009 and 2017.

The new volume concentrates on the various forms of the humble, but effective, dipole-family.

Like the first book, the main aim of this one is the use of the *EZNEC* modelling and *AutoEZ* optimisation programs, which I have covered here before.

After picking the book up it becomes clear that, although intended for modelling, is also a good reference for those looking to learn the very basics of how aerials work. Written in two parts, the book begins with fundamentals. The reader is taken through subjects such as electric and magnetic fields and the induction and radiated fields associated with every aerial.

Some fundamental calculations are included and, naturally, subjects such as impedance, resistance and SWR are described in detail.

Of interest to many, I am sure, is a detailed discussion on the decibel, along with a very useful 'quick-reference' decibel/power ratio chart.

The second part of the book deals with the dipole, which as we know, has many forms.

A basic dipole can he horizontal, vertical, sloped, inverted and 'dog-legged'. Then there are the variations, such as the OCFD (Off-Centre Fed Dipole)/Windom, the doublet, including the G5RV and the ZS6BKZ variant. The book just about covers them all.

The title is well laid out, and there are many diagrams, which clearly illustrate what may be expected from the various designs and configurations.

These are re-enforced with files associated for each section and by some animated 'wizards'. These are .exe files that, when run, graphically demonstrate various properties of a design when changes are made to them. A few months ago, I described how the pattern of a dipole does change with frequency. There is a wizard here, named *Radiation With Increasing Frequency*, which demonstrates just that (Fig. 5).

For purchasers of the book, these extras are made available for download from the author's website.

Also available for download is a colour pdf-format copy of the book that may be viewed on a desktop, laptop or tablet making it ideal to read while 'on the move'.

There are also some Excel spreadsheets and pre-built models available for download as well.

The title demonstrates many 'what-if' predictions in cases where dipole configurations are changed.

Although aimed at the EZNEC modeller, I feel the book will also be of broader interest to those wishing to learn more about the workings of the dipole family.

The book (Fig. 6) is available from Amazon and at the time of writing is priced at £17.99 (paperback) and £7.62 for the Kindle Edition.

With all the extras that come with it, I feel that this book represents very good value.

https://tinyurl.com/y9xqkw49
https://tinyurl.com/y98gd3jw
https://tinyurl.com/y99df5hx

Kevin Ryan
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Kevin Ryan finds out more about SmartRadios by evaluating the Elan Connect+ from PURE Radio. He then sifts through the most exciting recent global DRM and DAB news.

1

PURE Elan Connect+

I was curious to find out whether a so-called 'smart' radio (*SmartRadio*) would offer anything new to us radio listeners, and I hoped that this was not just a 'marketing-name' for internet radio. I have several of these DAB/FM/Internet radios, such as the *John Lewis Octave* and my trusty *Roberts Stream 202,* which I purchased more than ten years ago. I have now also bought a *PURE Elan Connect+* receiver (Fig. 1) from the Pure online store.
https://www.pure.com

The radio looked like a slightly 'chunkier' version of the Pure Elan IR3 internet radio, which has been around for a while. There are two versions of the *PURE Elan Connect+*, and the larger one has twin speakers, adding £20 to the base price of £70. I also have a Pure internet radio called the *ONEflow*. This connects to its own online portal called *The Lounge*. The latter is still operational but closed to new users, or for any changes.

However, my new model uses the *Frontier Silicon* portal.

Out of the Box

The box lists nine main features, including internet radio, DAB+, Bluetooth, FM and that it has a battery mode as an alternative to the USB type power cable. Only a USB cable is included, no power adapter. There is a quick start user guide with very small print. A more detailed manual is available on the Pure website. While searching the products' list on the website I couldn't find the radio under the *SmartRadio* category; it was simply listed as an 'internet radio'. I am sure this will change sometime soon.
https://tinyurl.com/y5ddnxmo

On Power-up

I decided to use battery power and inserted four new AA alkaline batteries. There are no clever charging features on this radio; if you want to use rechargeable batteries then you will have to recharge them in a separate battery charger. The radio started its setup routine by slowly scrolling through an invitation to visit the privacy page at the *frontiersmart.com* website; eventually, a message to *press select* came up. This launched the setup wizard. The wizard asks you to choose the settings for the time format, whether you want daylight saving to be used, and where you want to get your time updates from. Then the wizard appears and the method you choose will depend on your router. Hopefully, you will see the message that the radio has connected. If not, you will have to start over and check everything.

The UNDOK App

Out of curiosity, I tried the *UNDOK* app. This lets you control your radio from your mobile phone or tablet. The app easily found the Elan and connected (Fig. 2). *UNDOK* gave me access to the menus; it is much easier to use the mobile phone keyboard, rather than the multi-function knob to control the device.
https://tinyurl.com/y56qaxd8

The Radio Portal

When the portal opened, I could see that it had the usual 'list-format' of the normal *Frontier Silicon* portal but that the entries were different (Fig. 3). The *SmartRadio* list contains entries on *UK, Search, Location, Popular and Discover*, while the more 'typical' list on internet radios is *My Favourites, Local UK, Stations, BBC, Podcasts, My Added Stations*, and *Help*. The *Help* option has a code to let you connect your radio to the *Frontier Silicon* portal. However, this option is not available on the *SmartRadio*.
https://smartradio.frontier-nuvola.net

The Main Menu

The menu items on the portal each have several sub-menus, and many stations include podcasts and a link to the other stations in their commercial group or provided by a national broadcaster. For example, when you select BBC Radio 4, there are options to choose BBC Radio 4, another BBC station, or related podcasts from Radio 4; selecting LBC Radio has options for LBC, other stations owned by Global Radio or LBC podcasts. Be prepared for some 'surprises'. For example, I found two streams for the BBC World Service and in one of them, the only related podcast was Midlands Politics.

The UK Sub-Menu

The UK menu item expands to *Local Stations, Popular, BBC, Genres* and *Cities*. A quick check showed that there were no 'intruders' in the list of BBC stations but I didn't check if any of them were missing.

The UK Cities Feature

There were 22 entries in the *Cities* list, starting with Aberdeen and ending in York. However, not all the official cities in the UK are to be found on the list. For example, if you live in Winchester or Truro you won't find your city listed. By contrast, there is an entry for the market town of Mansfield.

Picking the city of Norwich at random where the only entry is Radio Caroline Flashback (it broadcasts on the trial small scale DAB multiplexes in Norwich and Cambridge) gave me the option of listening to related stations, for instance, Radio

ALL PICTURES: KEVIN RYAN

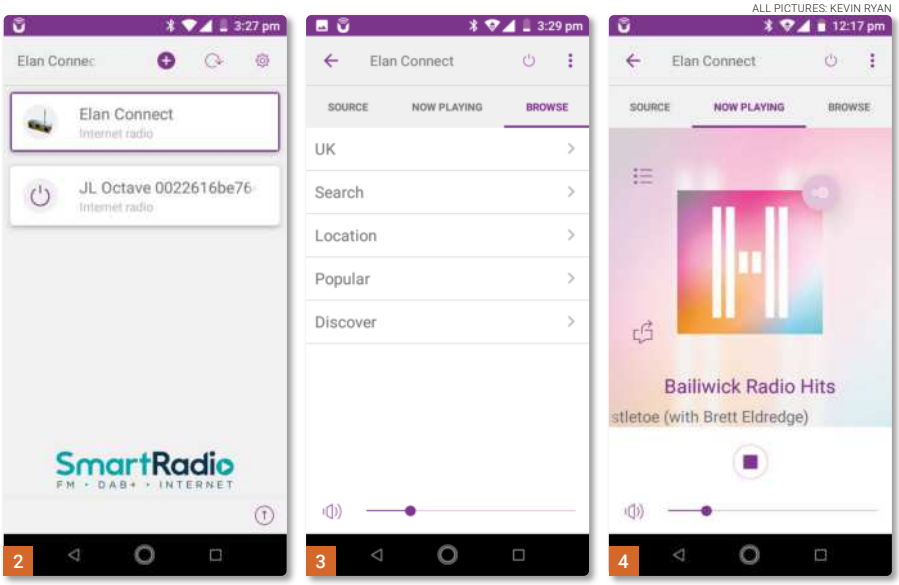


Fig. 1: The *PURE Elan Connect Plus* receiving one of the internet streams from the *BBC World Service*. Fig. 2: The *UNDOK* app easily latched on to the *Elan Connect+*. Note the *SmartRadio* branding in the latest version of the app. Fig. 3: The menu on a *SmartRadio* is different from the choices offered on internet radios, as shown on the *UNDOK* app. Fig. 4: I found two stations from *Bailiwick Broadcasting*, due to begin broadcasting to the Channel Islands on DAB later this year. Fig. 5: *Radio Nacional Amazonia* is directed towards the Amazon and is also transmitting a good signal towards the Caribbean.

Caroline. Of course, other stations cover Norwich. However, they do not appear in this 'filtered' list.

UK Genres

Still working from the bottom of the menu upwards, I looked at the *Genres*, of which there were 23 listed. This is close to the 22 cities but that is probably just a coincidence rather than some limit in the size of these categories. The usual genres such as *News* and *Pop* have some interesting additions such as *College, Freeform Eclectic, Hip-Hop Rap* and *Public Community*. The *College* stations entry offers many of the student radio stations I recognize. The *Public Community* section has, as you would expect, community radio stations and a helpful link to all the BFBS stations.

UK Popular Stations

The list of *Popular* stations contained mainly BBC stations in the top-10. I do not know how the list is compiled and whether it is based on the actual number of times the streams were accessed (presumably highest to lowest, or some other criteria, such as RAJAR listener data).

The *Local Stations* list seemed to be a general mix of all types of stations. I think that it would be better organized by UK *counties*, just to help listeners find their local stations.

The Search Sub-Menu

The *Search* facility uses the cumbersome linear type of keyboard, where you have to move through every character to find the ones you want, although the *FF* and *REW* keys jump in/out of the list to the *OK* and *Backspace* keys. The radio helpfully stays on the search page until the user either clicks *OK* or exits, rather than hopping back to the screen showing the station being played.

The Location Sub-Menu

This is the familiar category-based sorting of stations by continent and then countries. I could not see anything new here, but it is good to have the whole database of stations available.

The Popular Sub-Menu

This list of popular stations lists stations from countries other than the UK, mainly from Germany. I spotted a few French stations as well. I tried changing the radio's language to French under *Settings* to see if this might change the filtering of the stations, but this had no effect. These devices usually configure themselves by detecting the user's IP address.

The Discover Sub-Menu

The *Discover* option searches the entire database of radio stations. The search has options to either use the *Origin* (the region or country to filter the list), *Genre* that has a handful of extra ones not in the UK-centric list, or *Language*. I decided to follow a search of stations from Ireland and got a list of towns. I noticed that places that have a community radio station were in the majority. To obtain a complete station list I had to select *'Everyting* [sic] *from Ireland'*.

Intrigued by this kind of 'filtering' in the database, I tried the same with the UK, with just too many places to count. I scrolled to Reading. The radio showed four stations, including BBC Berkshire, Heart Berkshire, Smooth Berkshire.

There was one I had never heard of, called *1940's Radio Station*. It did not connect to a stream.

In my view, one annoying feature of the movement through the 'levels' of the *Discovery* process is that filtering the list in stages *down* the tree works well. However, when you decide to go back *up* the discovery tree, pressing the back button sends you right to the top-level list. I also learned not to scroll too quickly through a list as large as UK places otherwise you once again end up right back at the station list.

What Should It Do?

I went back to the website dedicated to *SmartRadio* to look again at its benefits.

These are listed as: *Always Available without Wi-Fi or 4G/5G* (this must be DAB/FM); *Global Content* (obviously from the internet); *On-Demand Streaming* (podcasts and, I suppose, live-streams as well); and *Future Proof* (this would apply to internet stations and software updates). Updating the *DAB Decoder* should be possible via a software update.

Having listed the radio's shortcomings earlier, I must also highlight a key advantage: as a 'search-tool', the *Elan Connect+* 'filtered' lists are a big help to discover new and different radio stations that you may have been completely unaware of.

For instance, I found two stations from Bailiwick Broadcasting (Fig. 4). They should appear on the Channel Islands local DAB multiplex in due course.

Other Observations

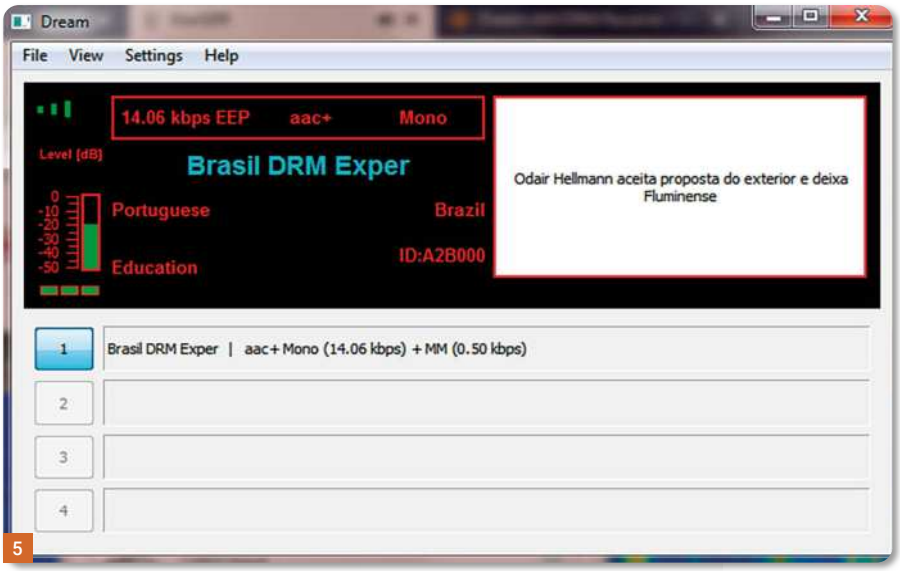
A software update appeared shortly after I completed the setup. At this point, the radio was on battery power and the on-screen message recommended mains power. I plugged the USB cable into my PC, and it looked like the update had been done. A little while later, the same message appeared again; this time, I plugged the radio into the mains, at which point the update downloaded and installed.

I did not spend a lot of time on DAB, other

than to check the sensitivity of the radio: I found this to be about average for this type of portable with a telescopic antenna. I did not spot anything new in the DAB menu.

The only sockets on the rear of the unit are for headphones and USB charging. The preset buttons are down to 3 with the third one labelled as '3+'. This affords access to the remainder of the 20 presets – a 'block' for each of the three different modes of reception. Without access to the portal, there currently is no way to increase the number of favourite internet stations.

Finally, there is a time lag between using the multi-function rotary knob to select a *station* and the return to *volume* control. It seemed too long to me and frustrating when you forget.



5

Overall View

I am fairly sure I explored all the features of the *SmartRadio*. The guided method of moving the listener through the vast database of 55k radio stations and 27k podcasts is a welcome approach. The question I am struggling to answer is whether this makes the Elan Connect+ a 'smart' radio because it does not have the features of a smart speaker. Equally, I cannot say what a 'smart' radio should do, because if it behaved as *BBC Sounds* used to, and attempted to give you radio stations or podcasts based on some hidden user profile, then I think that approach would quickly turn me off. I suppose the first generation of a device is always a 'stab in the dark', as to which features to include. I think that the database administrators need to do more research to improve the accuracy of the information in the database. For example, *Sennen* is listed. I think that this may be 'Sennen Cove' in Cornwall. The associated station is Radio Scilly Isles, rather than BBC Cornwall.

DRM News

I enjoyed solid reception of Radio Nacional de Amazonia on 11910 kHz (Fig. 5) on a remote receiver in the Caribbean. The SNR was 20dB and the 12 kHz audio in Portuguese was crisp and clear, all delivered by a 1.12 kW transmitter. The transmission included a slideshow, but *DReaM* does not display images sent using this method. The Voice of America (VOA) will probably soon join Radio Marti again as a second channel on the experimental transmissions from Greenville on 7345 kHz. The VOA has not stated which languages they will use. The *DRMCast* broadcasts from TDF in France that used to send weather data as image files popped up on 9900kHz during December between 12.00 and 15.00 UTC. The same station appeared briefly on 7405 and 15285 kHz. Some monitors reported that the station often started with no station label, but that this appeared several minutes later. KTWR has a new weekly five-minute DX programme during its DRM service to India on 13800 kHz on Sundays from 1026 to 1056 UTC. The *DXers Diary* program begins on 3 January. It is designed to make it easy for listeners to contribute to the advancement of the DXing hobby. You may send log entries and other discussion contributions to this address:
dxersdiary@gmail.com

A company called *DPA Mac LLC* plans to build yet another station using DRM to transfer financial trading information between the USA and Europe and has applied to the FCC for a construction permit. The single 2kW transmitter will be located at Maple Park, Illinois. The company is seeking another site for an auxiliary transmitter. The FCC requires a DRM station to use a minimum of 10kW. The applicant is confident that 2kW will be enough to allow a standard DRM receiver to pick the signal. *DPA Mac LLC* claims its proposed service will provide timely, accurate, US financial news around the world in the form of a commercial-free public broadcast that will promote global interest in US companies and investment in the US economy. This service will use half the transmitted bandwidth, while the other half will likely have the encrypted financial trading data.

The DRM Consortium published a review of 2020 containing is a very interesting summary of what the group has been up to in 2020.
https://tinyurl.com/y43x38g2

Small-Scale DAB

Ofcom has published a list of applications received for the round-one deployment of small scale DAB, which closed in late November. Each area has at least one applicant to operate the multiplex, and Leeds attracted five. In parallel, Ofcom received nine community stations applications for the new digital licences. The regulator will publish the details of the applications in due course, followed by licence awards in batches. Round two of the deployment, covering Northwest England and Northeast Wales, should be advertised next month. The areas included in round three should be announced at the same time.

Some UK DAB Changes

Ofcom also reported on some recent changes to the services on local multiplexes. I cannot list every one of them and will instead highlight local services, such as Great Yorkshire Radio moving from the North Yorkshire multiplex to the Lincolnshire one. A new service for local communities called *Outreach Radio* started on the South Hampshire multiplex, and a Polish-language station is now available on the Surrey one.

DAB in the Car

Voice control and speech recognition are seen as essential features in the car dashboard, enabling drivers to search and change stations seamlessly while keeping their eyes on the road. The *WorldDAB Automotive Working Group* is consulting with vehicle manufacturers and broadcasters to develop DAB+ guidelines on using voice control as part of hybrid radio in the car. The new Guidelines are to be published in March 2021 as an extended version of the existing *WorldDAB User Experience (UX) Design Guidelines*.
https://tinyurl.com/y2hs6447

Tim Kirby
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This month, Tim Kirby explores the wonder of amateur radio from a beginner's perspective. He offers advice on getting (re-) started, when and where to listen to the amateur bands, and how to save some money in so doing.

1

The Fascination of Amateur Radio

A common definition of 'amateur radio' is as follows:

"Amateur radio, also known as ham radio, is the use of radio frequency spectrum for purposes of non-commercial exchange of messages, wireless experimentation, self-training, private recreation, radio-sport, contesting, and emergency communication. The term 'amateur' is used to specify 'a duly authorised person interested in radio-electric practice, with a purely personal aim and without pecuniary interest' (either direct monetary or another similar reward), and to differentiate it from commercial broadcasting, public safety (such as police and fire), or professional two-way radio services (such as maritime, aviation, taxis, etc.). The amateur radio service (amateur service and amateur-satellite service) is established by the International Telecommunication Union (ITU) through ITU Radio Regulations. National governments regulate technical and operational characteristics of transmissions and issue individual station licenses with a unique identifying call sign, which must be used in all transmissions. Amateur operators must hold an amateur radio license, which is obtained by passing a government test demonstrating adequate technical radio knowledge and legal knowledge of the host government's radio regulations. Radio amateurs are limited to the use of small frequency bands, the amateur radio bands, allocated throughout the radio spectrum, but within these bands are allowed to transmit on any frequency using a variety of voice, text, image, and data communications modes. This enables communication across a city, region, country, continent, the world, or even into space. In many countries, amateur radio operators may also send, receive, or relay radio communications between computers or transceivers connected to secure virtual private networks on the Internet."
(Source: Wikipedia)

In practical terms, an 'amateur' radio enthusiast is a radio hobbyist. Anyone can *listen* on the amateur bands, should they wish, no licence is required. However, to become a *transmitting* amateur, you need a licence which is issued, in the UK, by OFCOM, the Government department responsible for radio licencing and spectrum management.

To obtain a licence you'll need to take an examination (don't be put off!), which is administered by the Radio Society of Great Britain (RSGB), the leading amateur radio organisation in the UK.
http://www.rsgb.org

A Multi-faceted Hobby

Why might you want to take up amateur radio as a hobby? Well, this is an extremely diverse hobby covering many facets. You might enjoy contacting people across the world – or across your town. You might want to build your own transceiver or experiment with aerials. Perhaps you like the idea of communicating through an amateur radio satellite. Or, maybe, you enjoy CB Radio but would like to take your radio interest to different frequencies (Fig. 1).

It is also possible that you might like to experiment with digital voice communications, integrating radio with the Internet. Some people enjoy restoring vintage or military radio sets and putting them on the air. Others take the exam to challenge themselves in a different sphere of knowledge. Many radio amateurs take part in competitions ('contests') or try to win awards. And a good number of amateurs enjoy travelling to far off places, or hill/mountain tops – and operating from them. For all the things I have included here, there's just as many that I have left out.

There are three levels of amateur licence available in the UK:

Foundation Licence

This is the UK's 'entry-level' licence. Historically, local radio clubs have offered face-to-face training. However, it is now possible to prepare for the examination with either self-study or 'online', which people have done in record numbers during the COVID pandemic. Although the foundation licence only allows the holder to transmit a maximum power of 10W, there is a surprising amount that you can do with this, on both the HF (short wave) and VHF bands. UK Foundation licence holders are regularly heard around the world.

Most people take around 10 or 12 hours to study the required course material – time which can be spread out as you wish. *Essex Ham* is one of the leading course providers and has helped over 4,000 candidates to a Foundation exam. The course is entirely free, and you can read about it at this URL:
http://hamtrain.co.uk

Another fully-online course is available

Fig. 1: A converted CB set can provide a lot of fun on the 10m Amateur Band. Fig. 2: A dual-band VHF/UHF rig need not break the bank. Fig. 3: A simple vertical aerial can be effective, if out in the clear, and used with some radials. Fig.4: Perhaps you would like to try communicating with the International Space Station (ISS)? A handheld radio can do just that!

2

ALL PICTURES: TIM KIRBY


3

from the GM6DX group in Scotland – you can find the course at this website:
http://gm6dx.thinkific.com

However, you do not need to do an online course. You could study from the *RSGB's Foundation Manual* by yourself, but most people find the online tuition beneficial.

The examination itself costs £27.50 and can be taken on-line, with remote invigilation. There are 26 questions, and you will need to answer 19 of them correctly to pass. To book an exam, you can go to this URL:
https://tinyurl.com/y7pxyn44

Before the COVID-19 pandemic, candidates had to do a simple practical test also, but this is not currently required. After the exam, you'll receive an official notification from the RSGB Examinations Department after around 6 working days. If you've been successful, you'll receive information which will allow you to log in to OFCOM's licencing system to apply for your licence. You'll be able to choose a callsign from those that are available and then, once that's been issued to you, you'll be able to get on the amateur bands allocated to the foundation licence and operate, without supervision.

Intermediate Licence

To progress to the *Intermediate Licence*, you will first of all, need to have taken and passed, the Foundation examination. The Intermediate Licence allows you to transmit more power, 50W and also, to use some additional bands in the Microwave spectrum.

As with the Foundation Licence, there are online courses available, and of course, a book covering the Intermediate syllabus is available from the RSGB Bookshop. The GM6DX group also offer an Intermediate course which can be found at:
http://gm6dx.thinkific.com

There is another course available at the Online Amateur Radio Community (OARC):
https://tinyurl.com/y2xw5dpn

The examination itself consists of 46 questions and you'll need to answer 28 correctly to pass. You'll have 90 minutes to complete the exam, which, like the Foundation can be taken online with remote invigilation.

The cost of the Intermediate exam is £32.50.

As with the Foundation licence, you'll receive official notification of your exam result within six working days and, if you have been successful you will be provided with credentials allowing you to log onto OFCOM's licencing system to choose your new callsign. Once that has been issued, you'll be able to get on the bands using up to 50W in power.

Full Licence

You will need to have passed both the Foundation and Intermediate examinations before you can take the exam for the Full licence. With a full licence you can use up to 400W of power on most of the amateur bands and you will have access to all the UK amateur bands. You'll be able to obtain a licence overseas if you are travelling.

Home study, along with club or college-based courses are possibilities. The Bath Distance Learning Course has been extremely well received and successful. Keep an eye on their webpage for the announcement of their next Full licence course.:
https://badarc.webs.com/bath-training

You can take the exam online – once again with remote invigilation. The cost is £37.50, and the exam includes 58 questions, of which you'll need to answer 35 successfully. You'll have two hours to complete the exam. Taking the exam online means that you'll know your result immediately you've finished.

Once again, you'll receive official notification within 6 working days and if you've passed, you'll be able to access OFCOM's licencing system to obtain your new callsign.

Manuals for all three licences are available from the RSGB online bookshop at
https://tinyurl.com/y33yxdgw

In some ways, the three different licence levels may seem a bit daunting, but the good thing is that it is fairly straightforward to 'dip your toe in the water' with a Foundation Licence. It gets you on the air, experimenting and, hopefully, having fun! As you gain in experience you can decide if you wish to progress to Intermediate and Full licences. Although a considerable amount of study will be needed, it will be made easier by what you have learned on the air, yourself; and, of course, you can take as much time as you like to progress through the various levels.

Do I Have to learn Morse code?

Only if you want to! It used to be the case that, to get a *Full Licence*, you needed to pass a Morse code test. That requirement is long gone. Morse code is still used widely on the air, however, particularly on the short wave bands. However, there is no formal requirement to learn Morse. Do it if you want to – otherwise ignore it!

Lapsed Licences

You may ask, *"I had a licence before and let it lapse, do I have to take the examinations again?"*. The answer is that this should not be necessary. If you have some proof that you had a licence before; a licence document, an entry in an old callbook, maybe even a QSL card, it should be possible to arrange something. Give the OFCOM

Spectrum Licencing team a call (Tel: 0300 123 1000 or 020 7981 3131), and it will be able to guide you through what is needed to get your callsign back.

Have a Listen

It used to be that people who were interested in amateur radio served an apprenticeship of sorts, by listening on the amateur bands76 before they got a licence. This is less common these days, particularly as thankfully it is much easier to get involved and take an exam at an early stage. Nevertheless, you may find it interesting to have a listen to some of the amateur bands and get an idea of whether the hobby is for you.

Using your scanner, you may hear amateur activity on FM between 145 and 146MHz (the 2m amateur band) as well as between 430 and 434MHz (the 70cm amateur band).

Furthermore, if your scanner can receive DMR, you may hear transmissions on that mode, particularly in the 70cm band.

With a receiver capable of listening to the short wave bands, using upper and lower sideband mode (USB and LSB), you could try listening between 3650 and 3800khz in the afternoons and evenings. This is the 80m amateur band. During the day, listen between 7050 and 7200khz, the 40m amateur band as well as between 14100 and 14350khz, the 20m amateur band.

On the 40m and 80m bands, you will need to listen on LSB whereas, on the 20m band and above, you will need to use USB.

If you do not have your own receiver, then you can always use one of the WebSDR receivers which are available on the Internet. You could try the Hack Green HF and VHF SDRs:

http://hackgreensdr.org:8901
http://hackgreensdr.org:8902

What Do I Hear?

As you listen, you will hear stations giving their callsigns, generally, but not always, using the phonetic alphabet. Callsigns have a particular structure: The first part of the callsign is the *prefix* and indicates what *country* a station is in with the remainder of the callsign being a unique letter combination identifying the station.

Sometimes callsigns will have a suffix such as '/M' (indicating *mobile*). You can find a list of amateur radio prefixes here:

https://tinyurl.com/y5v5td2j

This will help you identify the country of the station that you are listening to. If you are interested in finding out more about the station you are listening to, do have a look here:

4

http://qrz.com

You can see whether they have a page there or not. Most people do and include a biography, with perhaps a picture or two. I quite often find out fascinating facts about people that way, which can be fun to talk to them about.

Is Amateur Radio Expensive?

Well, it depends! In many ways, there has never been a better time to be interested in amateur radio, from the point of view of the price of equipment. The availability of equipment from the Far East has changed things.

This means that you can buy an entirely adequate VHF/UHF handheld for around £30 (e.g. Fig. 2).

Of course, it will not have as many features as one costing 5 times as much. But it depends on what you want! For getting you started, a £30 handheld will, in all likelihood, provide you with a lot of fun for your money.

Of course, there is plenty of second-hand equipment you will see online. There are some bargains to be had, but in general, prices are quite high (good if you're selling, less so if you're not) and of course, it is not always clear what condition the equipment is in. You can be more confident, buying second hand from a reputable dealer, and it may be worth paying their mark-up for the warranty which will hopefully ease you through any problems that might occur. Buying equipment from people you know, perhaps through a local club newsletter or forum is another good option.

Table 1 has some websites liking to the main dealers' second-hand listings:

An Entanglement of Aerials

For HF, in particular, you will see all sorts of advertisements for different aerials, which seem to 'promise the world'. As you get started, why not try making a half-wave dipole? You'll just need a bit of coaxial cable from the centre of the dipole to where your radio is, terminated with a suitable connector for your radio, a dipole centre (a choc block will suffice if you're stuck!) and some wire for the dipole legs.

The length of the dipole legs can be calculated based on the band/frequency you want to use.

There are a few websites which will do this calculation for you, simply search for 'Half Wave Dipole Calculator':

https://tinyurl.com/y6qlgag5

Get your dipole up as high as you can! If you have to bend the legs to get it to fit in your garden, try it! It often works just fine. A vertical aerial (Fig. 3) is easy to make too – think about making a quarter-wave vertical for a band of choice, perhaps. A quarter-wave radiator and some ground radials will work a treat.

You'll need an SWR meter to check the aerial is matched correctly – but your rig may have SWR measurement built-in or, in any case, a meter will be an important part of your station as time goes on.

In case of any aerial-related questions, you could always contact my colleague Keith Rawlings, the author of the *Aerials Now* column in this magazine.

The Great Magic of Radio

So, if (like me) you are captivated by the magic of radio; how it works, how invisible signals can cross the globe –

And beyond (Fig. 4), If you marvel at the surprise when someone in a distant place replies to your call, perhaps, amateur radio might be for you.

Please do not forget to investigate our sister magazine *Practical Wireless*, which will take you much further than I ever can in this article.

However, I do hope this article has whetted your appetite and given you an idea of the ways that you might be able to get involved. If you do, I hope to hear you on the air!

Further Reading

- Tilley, D. (2020) 'Amateur Radio on a Budget (Part 1)' *Practical Wireless*, January 2021: 58
- Redwood, Colin: Check out the ongoing series of articles in *Practical Wireless*
- RSGB: **https://tinyurl.com/y3ty2x2v**

Scotland

Somerset

South Yorkshire

Suffolk

Insurance

DealerGuide

For Sale

GENUINE RTL-SDR.COM PRODUCTS Triple-filtered Low Noise Amplifiers for ADS-B, Wideband LNAs, FM and AM stop-band filters. Latest Version 3 super stable RTL-SDR USB Stick with 1ppm TCXO and HF mode, software activated bias tee, longer SMA, clock and GPIO pads. Pigtails, connectors, adapters and many more useful items. Buy direct from our web shop at **technofix.uk** or **www.technofix.co.uk**

Wanted

VINTAGE FIREWORK COLLECTOR Do not light the blue touch paper and burn British heritage. Private collector will pay cash and collect from anywhere. Licensed explosive storage. **Call Tony on 07956 506300**

TradingPost

FOR SALE

AOR AR8000 SCANNER w leather case, original antenna + manual. Ser# 034479. Excellent working condition. Scratch-free screen and case. Separate metal desk stand. Optoelectronics Optolinx computer interface w designated AR8000 port + manual. NB. 3x flat-ribbon cables included. RadioControl AR8000 v1.2 Lite software w licence. £100 ono +pnp. **Noel 0747 952 0285 or pnoelw@yahoo.com**

TECSUN PL-360 w plug-in AM antenna, pouch, usb charging cable, belt clip, earphones, clip on wire antenna + manual. Excellent working condition. Scratch-free screen and case. £25 +pnp. **Noel 0747 952 0285 or pnoelw@yahoo.com**

FUNCUBE DONGLE PRO+. Perfect working condition. £60. **Noel 0747 952 0285 or pnoelw@yahoo.com**

ALTRON 40' 3 section mast plus head unit . Good condition, no ground post. J beam TB3 antenna. Some other elements for high gain TH6 £200 **01945 773080 WISBECH LINCS**

WANTED

PHILIPS ELECTRONIC ENGINEER EE8 KIT. In any condition, or just incomplete or broken parts. Even the box lid (with its picture) would bring back happy memories! **Godfrey G4GLM. (020) 8958 5113. cgmm2@btinternet.com**

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RECEIVERS

ICOM IC-R8600

100kHz-3GHz Receiver with SDR Technology from IC-7300.

The IC-R8600 replaces the IC-R8500 wideband receiver and features technology incorporated into Icom's best selling IC-7300. The IC-R8600 receives a wide frequency range from 0.01-3000MHz frequency in analogue and various digital modes (D-STAR, P25, NXDN and dPMR). The IC-R8600 also features a larger 4.3 inch touch screen display which displays a fast moving spectrum scope and waterfall display.

ML&S: £2499.95
Includes an Icom AD-55 PSU worth £49.95!

ELAD FDM-DUOr

A Receive-only Version of the famous FDM-DUO!

10kHz-54MHz Direct Conversion SDR Receiver.

SDR receiver that offers the possibility to operate stand-alone like traditional radio or attached to a Personal Computer discovering the possibilities offered by the SDR technologies. After the great success of the FDM-DUO transceiver the manufacturer now offers the "R" as a receiver — as to be expected by Elad in a sleek Italian design and equipped with top-notch technology.

- Frequency range: RX 9kHz to 54MHz direct sampling receiver + VHF undersampling reception
- 10 selectable and customisable filter pre-selectors
- Internal switch box for use with an external transceiver
- Stand-alone Modes: CW CW+ CW- LSB USB AM
- ADC Linear LTC2165,16bit clocked @122.88MHz
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- Stand-alone RX demodulator with STM32F4 ARM floating point µController
- LPC1766 Cortex M3 for LCD & Keyboard control
- Clocking source Si5338 drived by 10MHz TCXO or External reference input
- CAT USB interface with FTDI controller
- Fully managed by FDM-SW2 software included

ML&S: £759.95

AR-5700D RECEIVER

Advanced digital communications.

Frequency range 9kHz-3.7GHz. Tuning steps 1Hz-999.999kHz.

ML&S: £4595.95

AOR AR-DV1

Communications Receiver

Covers 100kHz to 1300MHz in traditional analogue modes (SSB, CW, AM, FM, S-FM, W-FM) as well as various digital modes. In fact, we know of no other radio in this category that can decode Icom's D-STAR mode, Yaesu's new C4FM mode, Alinco's digital mode, NXDN (note: 6.25kHz only), P25 Phase 1, etc. Plus lots of interesting features! www.HamRadio.co.uk/ardv1

ML&S: £1199.95

SDR RADIO

SDRPLAY RSPdx

New Mid-range SDRplay Radio.

Complete redesign of the popular mid-range RSP2pro 1kHz–2GHz.

ML&S: £194.95

Multiple antenna selection, Improved pre-selection filters, Even more software, Selectable attenuation steps, Special HDR (High Dynamic Range) mode for reception at frequencies below 2MHz.
Designed and made in Britain.

SDRPLAY RSP1a

Brand new design, the RSP1a is a major upgrade to the popular RSP1

ML&S: £94.95

Offering a powerful wideband full featured SDR covering 1kHz to 2GHz & up to 10MHz visible bandwidth. Better still, it's "Built & Designed in Britain"!!

RSPduo DUAL TUNER 14-BIT SDR

Dual-Tuner wideband full feature 14-bit SDR, 1kHz to 2GHz, 10MHz of spectrum visibility.

ML&S: £239.95

Simultaneously monitor 2 separate 2MHz bands of spectrum between 1kHz and 2GHz. 3 software selectable antenna inputs, & clocking features ideally suited to industrial, scientific, Ham & educational applications. Windows 10.

FUNcube Dongle Pro+

Wideband SDR Receiver. 150kHz-1.9GHz incl SAW Filters.

ML&S: £149.95

KerberosSDR

A Coherent RTL-SDR with 4x Channels.

For direction finding, passive radar, beam forming, or just as four RTL-SDRs!

ML&S: £179.95

HackRF One

HackRF One from Great Scott Gadgets is a Software Defined Radio peripheral capable of transmission or reception of radio signals from 1MHz to 6GHz.

ML&S: £219.95

DIGITAL & ANALOGUE

UNIDEN UBCD3600XLT

New digital TruckTracker V Professional Scanner Receiver, covers 25-1300MHz wideband frequencies.

The TruckTracker V operation allows this scanner to scan APCO 25 Phase 1 and Phase 2, DMR, Motorola, EDACS, LTR Trucked Systems as well as conventional analog and P25 digital channels.

ML&S: £449.95

ICOM IC-R6E

The 100 Ch/Sec Wideband Signal "Search Machine"

Communications handheld receiver. While retaining basic features of its popular predecessor the IC-R5, the IC-R6 contains many improvements including 100 channel per second scanning speed, 1,300 memory channels, 15 hours of continuous receive capability, optional drop-in charger stand and voice control squelch.

ML&S: £199.95

WHISTLER TRX-1 DIGITAL SCANNER

The Whistler TRX-1 Handheld Scanner is a multi-system adaptive digital trunking scanner with Motorola P25 Phase I, X2-TDMA, Phase II and DMR making it capable of monitoring unencrypted channels/systems.

ML&S: £419.95

AR-DV10

The ULTIMATE all mode digital handheld scanning receiver.

Latest firmware! 100kHz-1300MHz Analogue & Digital Modes.

ML&S: £969.95

ICOM IC-R30 SCANNER

The Icom IC-R30 has extremely wide coverage and supports all of the usual analogue modes (FM, AM, SSB, CW) as well a a few digital modes including NXDN, P25, DPMR and DSTAR. A worthy upgrade over the older IC-R20.

ML&S: £569.95

SF Screen Protectors

For Yaesu, Kenwood and Icom. *Maintain the value of your radios with professional screen protectors. No more scratched displays, the screen protectors last for years and protect reliably even at daily use.* ***ONLY £7.95***

ANTENNAS

BONITO RANGE AT ML&S

ANTENNA JET AAS300

ML&S ONLY: £234.95

A USB powered antenna splitter designed to work between 9kHz and 300MHz. Now you can use your one antenna with up to 3 receivers simultaneously. Finally, you can listen to marine band traffic, The Archers on Radio 4 and the air band at the same time (provided your antenna will cover it all!)

ANTENNA JET ASM300

ML&S ONLY: £189.95

A USB controlled antenna switch and mixer. It can be used as a simple switch, or can be used to switch in more than one antenna, to aid receiving to an optimum performance.

BONI-WHIP (PSU needed)

The active antenna that is raved about. Covering 20kHz to 300MHz and ideal for times when you can't erect a wire antenna. For home, for travelling and for DX camps. And despite the whip being only 4 inches long, it actually works!

ML&S ONLY: £109.95

GigActiv GA3005

ML&S ONLY: £386.95

A portable active antenna capable of covering 9kHz to 3GHz. Perfect if you are say on holiday and want to have a listen to the bands. You'll need to provide it with 5V via a USB cable (included) and some coax but it is just ready to go.

Diamond D-777

VHF/UHF air band receiving antenna, *not for transmitting. 3.4dB on VHF (120MHz) and 5.5dB UHF (300MHz) with an approximate length of 1.7 metres. The antenna is constructed from fibre glass materials and it is pre-tuned and fully weatherproofed. Mounting components are included. It's fitted with an SO239 connector, so can be connected to a PL-259 without the need of an adaptor. Tuned to receive 108-137.975MHz civilian air band, 225-400MHz military air band.*

RRP: £83.94 ML&S ONLY: £62.95

Diamond D-130M

Super Discone 25-1.3GHz
The D-130M Super Discone Antenna is an ultra-wideband antenna covering amateur radio, commercial 2-way, cellular, air traffic control and various utility frequency bands. Rust-free stainless steel is employed in major component parts making the antenna rust resistant and durable with 15m cable included with PL-259s.

ML&S ONLY: £124.95

MyDEL Smart Wire Kit

The MyDEL Smart Wire Kit antenna pack includes; 132ft of high quality flex-weave wire, 2x 3 metres of nylon guy rope and 2x heavy duty dog bone insulators.

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