STARLITE

The Award Winning Newsletter for Members and Friends of

Stourbridge and District Amateur Radio Society

Incorporating

Old Swinford Hospital School Radio Club

G6OI
G6SRS

G4CVK

Issue Number 07/2016

Stourbridge and District Amateur Radio Society

Meetings Held at

Old Swinford Hospital School
Heath Lane
Stourbridge
(8:00pm to 10:00pm)

Visitors always welcome
The Society holds its full meetings
on the 1st and 3rd Monday each month

RSGB Affiliated Society

STARLITE

Word from the President

Editors Comments

Firstly I most pass on our thanks to Moonraker (UK) limited (http://www.moonracker.eu) for the help and generosity and a personal thanks to Justin Godfrey, sale director of Moonraker for his help. This month edition we go from the start of amateur radio with First Amateur Radio License to the possible future of Radio with Digital Voice Communication.

Brush up your theory

Answers to last month: Question 1 - C Question 2 - B Question 3 - D Question 4 - A Question 5 – C

1. A receiver is quoted as having a sensitivity of 0.5µVfor 20 dB S/N ratio. This latter refers to a comparison between:

(a) Unwanted signal and wanted noise.
(b) Wanted signal and unwanted noise.
(c) Unwanted signal and unwanted noise.
(d) Wanted signal and wanted noise.

2. In an AM transmitter using 100% modulation the output voltage can:

(a) Only be half the average output voltage.
(b) Never exceed the average output voltage.
(c) Rise to twice the average output voltage.
(d) Rise to four times the average output voltage

3. The velocity of propagation on coaxial cable is:

(a) Greater than in free space.
(b) The same as in free space.
(c) Less than in free space.
(d) Zero.

4. Messages can be sent on behalf of:

(a) The Water Authority.
(b) British Rail.
(c) The Red Cross.
(d) A private company.

5. The equivalent DC battery voltage to give the same heating effect as a 12 V RMS sine wave source is:

(a) 6 V
(b) 8.4 V
(c) 12 V
(d) 17 V

6. The period of a sine wave is 12.5µS. This corresponds to a frequency of:
(a) 80 Hz
(b) 8 kHz
(c) 80 kHz
(d) 800 kHz
(e) none of the above ?

First Amateur Radio Licenses Issued: First Ham Licenses

In the earliest days of amateur radio, radio transmissions were not regulated and no licenses were required. Soon legislation was introduced and licenses were needed.

With the discovery of radio, people had very little idea of what it could be used for, let alone any regulatory position. As a result use of the radio spectrum was totally unregulated. No licenses were needed and anybody could take to the airwaves.

This state of affairs could not last for long otherwise anarchy would reign. Governments started to realise this and legislation was introduced and licenses started to be issued.

These decisions made in a period in the history of amateur radio are still felt today as call signs and licenses are required for amateur radio stations.

Before amateur radio license

In the early days of wireless communications, few had any concept of how the technology would develop.

Professionals and amateur experimenters alike were free to use the new medium of wireless as they wanted. No licenses were required.

Initially governments had little concept of what wireless or radio was capable of, or what controls were needed. However this soon started to change.

UK wireless legislation

In the UK the road towards legislation and licenses for both amateur radio enthusiasts and professional alike started in 1903. The International Telegraph Conference held in London between 26 May and 10 July 1903. Also a later International Conference on Wireless Telegraphy took place in Berlin in August of that year. It is highly likely that discussions at these two events influenced the British Government with the result that they sought to introduce legislation.

It did not take long before the Government acted because the Wireless telegraphy Act 1904 became law on 15th August 1904. It remained in force until 31st July 1906 after which it was extended on an annual basis until it was replaced by the Wireless telegraphy Act of 1924.

This act was probably the first legislation globally seeking to control wireless telegraphy.

The reasoning for the legislation came out of the report of the Post Master General (under whose remit wireless telegraphy came) when he stated: "the strategic importance of Wireless Telegraphy and the fact that some form of centralised control is needed if we are to receive the fullest advantage from this new form of communication."

UK amateur radio licences

A direct consequence of the new UK legislation was that licenses needed to be issued. The first licenses were issued in 1905 and were entitled "Licence to use Wireless Telegraphy Equipment for Experimental Purposes."

A list of those who had been issued with these experimental licenses was compiled in June 1906 and includes the details of sixty eight people. The list included the name of the applicant, the proposed location of the installation, what was termed the 'Radius of Action', and the license status, i.e. granted, under consideration, etc.

One of the most famous with a license on the list was Ambrose Fleming the inventor of the diode valve and consultant to Marconi. It is also possible to see that stations were being set up in many parts of the country.

Interestingly, at this stage, the act does not seem to differentiate between professional and amateur radio licenses, although a note did appear under the entry for the De Forest Wireless Telegraph Syndicate entry as a commercial entry.

Also the requirement for using the license for experimental purposes has been established in the UK - an aspect that remained until licenses were revoked for the Second World War - nearly 40 years later.

USA amateur radio licenses

The first amateur radio licenses were a little later in coming in the USA.

Initially there was little interference between stations because the distances they could reach were only a few miles at most. As the technology improved, distances increased along with the number of radio amateurs.

With the increase in the levels of interference, the US Congress started considering the possibility of legislation in 1910. After 2 years the Radio Act of 1912 became law and it placed a number of severe restrictions on radio amateurs in addition for the need for all amateur radio stations to be licensed.

The major obstacle was that all radio amateurs were to operate on a wavelength of 200 metres or shorter. At this time long distance communications used very long wavelengths, and the shorter wavelengths were thought to be of little value - these wavelengths could be used by amateur experimenters.

At the time, it was thought this restriction could bring about the end of amateur radio, but after an initial drop in numbers, the figure quickly started to rise.

Digital Voice Communication (Part One)

By Philip Cadman G4JCP

Whether you like it or not, digital voice communication is becoming popular in Amateur Radio. It's here and it's here to stay, but whether it will displace analogue voice communication is another matter. There are three major digital voice modes currently in use by radio amateurs: D-Star, System Fusion and DMR.

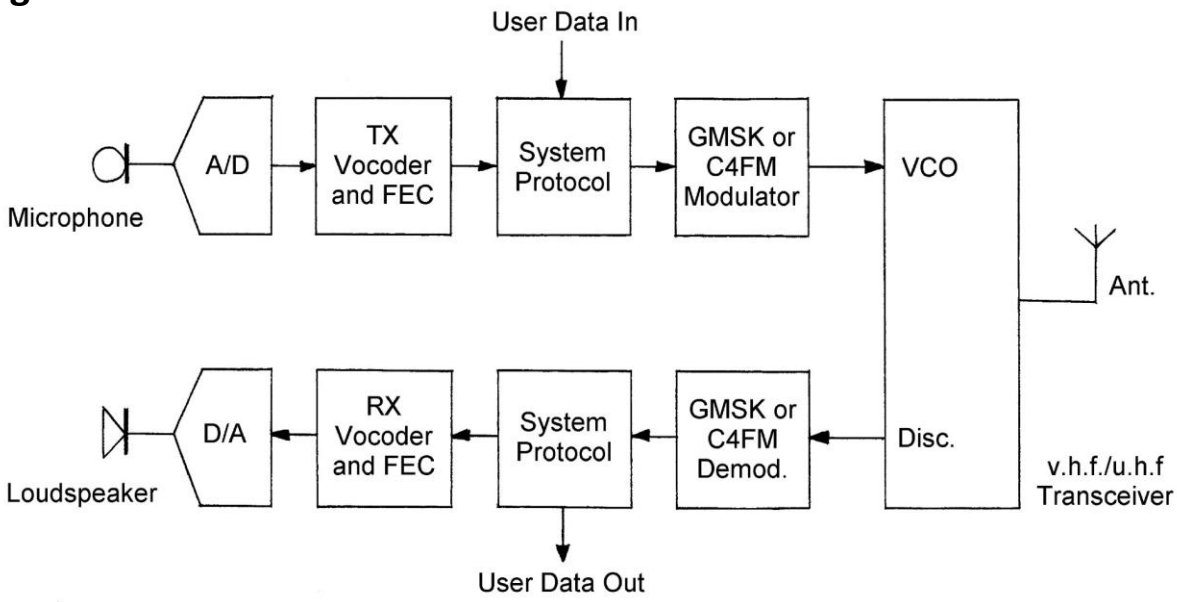
D-Star is short for Digital Smart Technologies for Amateur Radio, a system developed by the Japan Amateur Radio League (JARL) and marketed primarily by Icom. D-Star was designed solely for amateur use but uses techniques developed by the private mobile radio industry. It is the least technically advanced of the three systems but it has the advantage of simplicity and 'hackability'. That is, the system - although not the radios themselves - can be modified and enhanced relatively easily and this has been done and is continuing.

System Fusion is Yaesu's answer to D-Star. And like D-Star it has been designed exclusively for amateur use whilst borrowing techniques from the commercial sector. The term 'fusion' alludes to the system's ability to handle both digital voice and analogue f.m. transmissions in a somewhat seamless manner. The system has only recently been introduced and so there are far fewer amateurs using Fusion than D-Star. I'll just use the word 'Fusion' for Yaesu's system from now on.

DMR is short for Digital Mobile Radio and is a rather generic term. However, in amateur use, DMR is usually understood to mean a time division multiplex system manufactured by Motorola (known as Mototrbo). Hytera, Connect Systems and a few other companies also market DMR radios and systems. Unlike D-Star and Fusion, it is a purely commercial system which has been 'tweaked' to serve the amateur community.

All three systems are conceptually the same although DMR differs from D-Star and Fusion in one fundamental way. As D-Star is the simplest and most widely used system, I'll base this article primarily on that system. By the way, I'm not going to cover the interlinking of repeaters via the Internet. Although all the systems rely heavily on the 'Net for linking, the subject is too involved and fluid to be included here. Digital voice is still a minority interest at the moment, so if you are interested in taking up the mode, find out which system(s) amateurs in your area are using and what repeaters are within your range. All three systems are sufficiently complex that having local amateurs with sufficient experience to guide you is highly desirable.

Fig. 1



Digital Voice Transceivers

Figure 1. shows those stages present in a typical digital voice transceiver which are not present in an analogue transceiver. I believe all current amateur digital voice transceivers can also operate in analogue modes as well. The operator's voice is picked up by the set's microphone and the signal is amplified in the usual way. It's then fed to an analogue to digital (A/D) converter. The output from the A/D converter is a stream of binary numbers usually running at 8,000 samples per second. The converter will most often produce either 16-bit linear samples or 8-bit companded samples, depending on what the transmit vocoder requires. Vocoder is short for Voice Coder, and it's this component which makes digital voice over narrow radio channels possible.

As I've said, the A/D converter produces - as a minimum - 8,000 8-bit samples every second. That's 64,000 bits per second (bps). Simply modulating a carrier with this bit stream would result in a transmission that occupied a ridiculously wide bandwidth. The number of bits per second has to be reduced somehow. Audio compression techniques used for downloaded music files and for broadcasting are not suitable. They simply don't reduce the number of bits sufficiently, so the vocoder takes a different approach.

The audio bit stream is 'chopped up' into 20mS chunks. Each chunk is analysed using Fourier techniques and certain parameters such as the fundamental frequency and number and amplitude of harmonics - are extracted. Other characteristics are also noted. Don't ask me to go deeper, this is a hellishly complicated subject, one which I don't understand myself. You can liken the output of the vocoder to a music score, it isn't quite that, but it's going that way.

The vocoder used by D-Star is made by Digital Voice Systems Inc. (DVSI) and is called AMBE - short for Advanced Multi-Band Excitation and it's widely used in commercial systems. Although DVSI will sell you a chip called a vocoder, the vocoder is really just an algorithm implemented in software. Some amateur (and commercial) digital voice transceivers use just such a chip - the AMBE-2020, for example - while other sets use software licensed from DVSI running on a general-purpose digital signal processing (DSP) chip fitted in the radio.

In the case of D-Star, the encoded voice output from the vocoder is just 2,400bps. That's a big reduction from 64,000bps. However, unlike human speech, which has natural redundancy, there is no redundancy in the vocoder's output bit stream. Errors are to be strenuously avoided, so the AMBE vocoder can apply forward error correction (FEC). The D-Star voice data includes 1,200bps of FEC coding, giving a total voice bit rate of 3,600bps. So even if quite a few bits are received in error, the correct voice data can be recovered. We can't just send the voice bit stream over the air as-is, extra bits are needed to format the data and to provide identification and routing information. There is also user data to include as well. In the case of D-Star, an additional 1,200bps are allocated for this purpose, making the total transmitted bit rate equal to 4,800bps.

The next step is to frequency modulate the r.f. carrier with the data stream. This is done by shifting the carrier from its nominal frequency in sympathy with the data. It's good-old frequency shift keying (f.s.k.). However, D-Star uses a particular form of f.s.k. known as Minimum Shift Keying (MSK). All that means is the frequency shift is half the transmitted symbol rate. D-Star uses two-level f.s.k. so the symbol rate is the same as the bit rate, that is, 4,800 symbols per second. So the frequency shift is just 2,400Hz. Or put another way, plus and minus 1,200Hz from the nominal carrier frequency.

We're not quite finished yet. Even though the symbol rate is certainly low enough, modulating the carrier with a rectangular waveform will still produce an unacceptably wide transmission. The solution is to shape the data waveform by sending it through a low-pass filter prior to applying it to the voltage controlled oscillator (v.c.o.) in the transmitter. A Gaussian filter characteristic is chosen as that produces a sufficiently narrow transmitted bandwidth. Indeed, a D-Star transmission is approximately half that of a conventional 12.5kHz f.m. transmission. So that's what the GMSK in D-Star means: Gaussian Minimum Shift Keying.

The receive path through a digital voice transceiver is basically the reverse of the transmit path. The output from the radio's f.m. discriminator is first low-pass filtered to remove high-frequency noise and then fed to a clock and data recovery circuit. Note that the output from the discriminator must not be high-pass filtered as the GMSK signal has low frequency components which extend almost to d.c. The recovered bit stream is then analysed and split up into its component parts, that is, the formatting and identification data, the digital voice (and FEC) data and the user data.

The voice data is sent to the receive vocoder which then reconstitutes the analogue voice signal as a sequence of numbers. A digital to analogue (D/A) converter followed by some filtering and audio power amplification completes the chain. Although I've shown the transmit and receive vocoders as separate entities, they are almost always combined in the same physical device. For

instance, the AMBE-2020 chip can both encode and decode voice data but not at the same time. **A Bit Like Packet Radio**

So what actually goes over the air? Well, it's a little reminiscent of Packet Radio, as Figure 2. shows. At the start of an 'over', the transmitter turns on and sends a repetitive bit pattern. This pattern lasts for as long as it takes for the transmitter's output to reach full power plus sufficient time for the distant receiver to detect the signal and lock onto the received bit stream. Then comes a specific 15-bit pattern - the frame sync. - which tells the receiver that the next 660 bits are the transmission's header. The header contains some system data (the flags) plus source and destination callsigns. The callsigns of any repeaters that are to be used to route the transmission are also included here. The entire header is protected by some very strong FEC which allows multiple errors to be corrected.

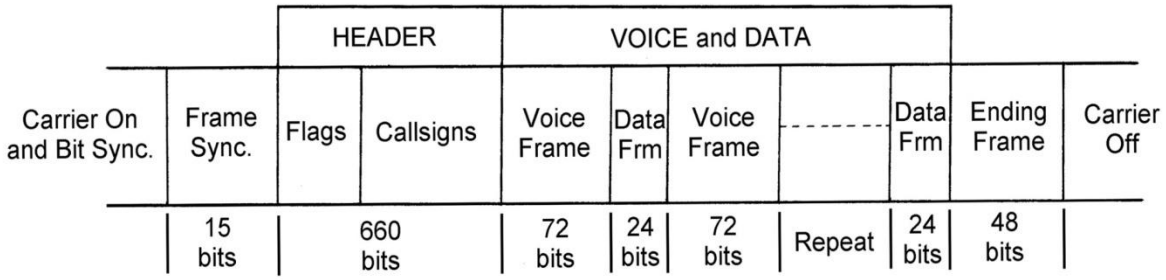


Fig. 2

Following the header is the digital voice data and user data. Each 20mS chunk of voice audio is sent as a frame of 72 bits which is followed by a 24-bit frame of user data. This pattern repeats for as long as the transmission lasts. The end of the transmission is marked by a special 48-bit ending frame and then the transmitter cuts carrier. There are a couple of points to note about the data frames. Firstly, they include some data used by Icom transceivers which is not in the official JARL D-Star specification. And secondly, the first data frame and every subsequent 21st frame contain a special bit pattern that is used for synchronisation. If a transmission is temporarily lost then these synchronisation frames allow the receiver to lock back onto the voice and user data frames.

With apologies in advance to any D-Star adherents, I must mention one significant shortcoming of the D-Star protocol. I do so because it's important when comparing digital voice systems. When a transmission is directed at a repeater, the repeater examines the transmission's header to see if it should route the transmission to somewhere else. This applies whether the repeater is only going to rebroadcast the transmission locally, or route it to a distant repeater via the Internet. If the header is corrupted to a degree where the FEC cannot cope, or if the header is lost altogether (which can happen if stations 'double'), then the transmission is ignored by the repeater. An entire over can be lost this way. In addition, the 15-bit frame sync. pattern is totally unprotected. So if that has even a single error it will be lost and the following header will be ignored. Please note that this shortcoming is of no real significance with ordinary simplex QSOs.

Mini Mobiles

Have you ever noticed that things get smaller before they get bigger? Mobile phones and music formats all shrank before expanding again. It would seem the transceiver is going down the same route.
The mini mobile dual band transceiver has been with us for a short while and is starting to get a foot hold in the transceiver market. No one can argue with the cost but what are you getting for your money.

Thanks to Moonraker (UK) Ltd and a good friend I obtain on loan a Baojie BJ-218 and a Moonraker MT-270M, two mini mobile with almost identical specifications but totally different.

BJ-218

Frequency Range VHF: 136.000 - 174.000MHz
UHF: 400.000 - 470.000MHz
System F3E(FM)
Antenna impedance 50Ω
Frequency stability ±2.5ppm @ -10°C ~ +60°C
Input voltage Direct current 13.8V (±15%), negetive grounding
Output power High Power : ≤25W
Middle Power : ≤10W
Low Power : ≤5W
Max Frequency deviation ±5KHz
Noise radiation ≤-60dB
Flexibility ≤0.2uV(12dB SINAD)
Max. Audio output 2W
Working current Receive 0.3A(SQL)
Transmit 5A(Max.)
Dimension 105 x 30 x 106mm
Weight about 300g

MT-270M

Frequency Range: VHF:136-174MHz
UHF:400-480MHz
Number of Channel: 200
Channel Spacing: 25KHz 20K 12.5
Phase lock step: 5KHz、6.25 KHz、10 KHz、12.5 KHz、15 KHz、25 KHz
Working Voltage: 13.8V DC±15%
Squelch way: CTCSS/DCS/5Tone/2Tone/DTMF
Frequency Stability: ±2.5ppm
Operating Temperature: -20~+60
Dimension(W x H x D): 98(W) x 35(H) x 118(D)mm
Weight: 408g
Receiver
Sensitivity
Broadband: ≤ 0.25μV
Narrow band: ≤ 0.35μV
Output power: 25W/20W(VHF/UHF)

The MT-270M is a touch more traditional in design with channel selection and volume control being controlled via knobs on the unit its self (channel selection can also be controlled from the microphone).
The BJ-218 on the other hand is 100% push button control. When it comes to the set up and operation, both sets are menu driven, if you have a modern handheld this will come almost as second nature to you. The pair are well stocked with options from the backlight colours down to offsets.
On the test bench both preformed well, if there is a down side it's in their receiving. It is said that the mini mobile is just a hand held in a metal case. I think this comes about due to their inability to receive weak signals. In a direct test, using the same antenna (X50), they both out performed a handheld, but not by much. What did strike me as odd was that both units received better on a small ¼ wave magmount antenna than on the much more powerful X50. TX is a different matter; both the BJ-218 and MT-270M are rated at 25w for 2 meter. The MT-270M has two power setting High and Low, on test into a dummy load I got 20w for the High and 14w for the Low.
Baojie's BJ-218 comes with three power setting H/M/L, testing returned 22w/13w/11w. Even on low settings both transmitted from Quarry Bank to Tewkesbury was not problem with a 5&7 report for both. Audio reports for both units' came back as good, very clear modulation missing a little on the base side.
Audio quality on the receive side was remarkable good for such small speakers, with the MT-270M just shading it for me with a slightly better base response. Another odd thing I found on the BJ-218 was the fact that it is dual monitor by default, if truth be told, I could not find any way of turning it off.

Scoring

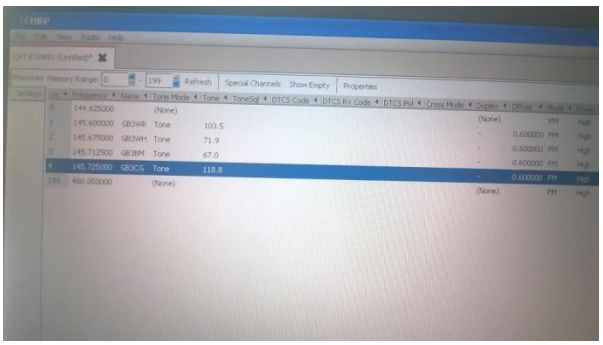
Build quality:
The MT-270M has the edge here. The unit look and feels more durable.
BJ-218: 6/10
MT-270M : 9/10

TX:
Both units are rated at 25/20w 2m/70cm in my test both fell short, but performed as well as any 2m transceiver costing twice as much. Both handled full power transmissions with ease, but the MT-270 go a lot hotter that the BJ-218.
BJ-218: 8/10
MT-270M: 8/10

RX:
Display on the BJ-218 is larger and therefore a little easier to read. However, the LED backlight on the MT-270M is far brighter, making the Baojie display look almost washed out, as seems to be the norm with the cheaper handhelds. In this case mini mobiles the signal meter (bar graph) is next to useless. Receiving is the big minus point on both units, in the straight fight the BJ-218 comes out on top being that little sharper on picking up weaker signals.
BJ-218: 6/10
MT-270M: 7/10

Design/Ease of use:
If you like clear lines and tidy arrangement of controls then is the BJ-218 that wins the race....but if you want ease of use especially on the two most used controls (volume & channel selector) then it has to be the MT-270M. As with most transceivers today the microphone plays a big part in the rigs operation. The MT-270M come with a big hefty fist microphone which I found a little too big, and I'm no fan of the PTT button which sticks out a bit far. The BJ-218 however comes with a much smaller mic, the build quality of which is nowhere near as good as its counterpart. The microphone on the Baojie plays a very big part in the transceiver operation and I have to admit that after a short while it became almost second nature when operating the rig.
BJ-218: 7/10
MT-270M 6/10

Programming:
Standard setup, frequency step, back light colours, bleep on or off etc. On both is easy and straight forward. Programming in repeaters however is a whole new ball game. Manual programming of repeater is possible on both rigs, but requires so many steps to make it almost unworkable to say the least.



Using my old (very old) laptop running windows XP, which I use for all my rig programming, I had a lot of difficulty in getting the MT-270M to talk to the software recommend for it and in the end I gave up and reverted back to 'Chrip'. Using the setting for a QTY KT-8900 I had no problem at all. Same laptop different transceiver, software for the BJ-218 worked first time no problem. Reading and writing to the rig with ease. One problem was noted, being that it made no difference what power level you set in the software it only ever set the power level on the rig to low.
BJ-218 8/10
MT-270M 6/10 (main for not working with its software)

Conclusion
The old saying is "You pays your money and you takes your choice". On paper the Baojie BJ-218 comes out on top. If it was me however, I would pick the MT-270M for a couple of reason. One I hate the dual monitor on the BJ-218 it drove me mad being on one frequency and the other frequency cutting in sometimes over the person you are holding a conversation with. Two I just really like the styling of the MT-270M. Although small it looks like it has something about it.
If your need is for a small ease to fit, almost anywhere in your car, short range mobile rig then look no further.

Our thanks to Moonraker for the loan of the MT-270M

UK Rallies

Rallies/Events over the next month around the UK

3 July 20th Red Rose QRP Festival *NEW VENUE*
The Rose Centre (Lowton Civic Hall), Hesketh Meadow Lane, Lowton, Warrington, WA3 2AH. Easy access: M6, M61, M60, A580
Open 11:00 to 15:00. Admission £2.00/Kids free.
Contact Les Jackson, G4HZJ, 01942-870634, g4hzj@ntlworld.com

2 July Bangor & DARS Rally [Saturday]
Donaghadee Community Centre, Manor Street, Donaghadee, Co Down, BT21 0HB.
Open 11:30. Admission £3.
Details: Harry, 02891-422762

9 July Stockport RS Rally [Saturday]
Walthew House, 112 Shaw Heath, Stockport, SK2 6QS.
Admission £2. Open 10:00/09:45.
Details: Nigel Roscoe, G0RXA, 07450-904422, info@g8srs.co.uk

17 July 2016 McMichhael Radio Rally
Reading Rugby Football Club, Holme Park Farm Lane, Sonning Lane, Sonning-on-Thames, Reading, RG4 6ST. Sonning Lane is on the B4446.
Admission £2. Open 09:30. Free parking
Details: Pete, G8FRC, 01189-695697, http://www.mcmichaelrally.org.uk

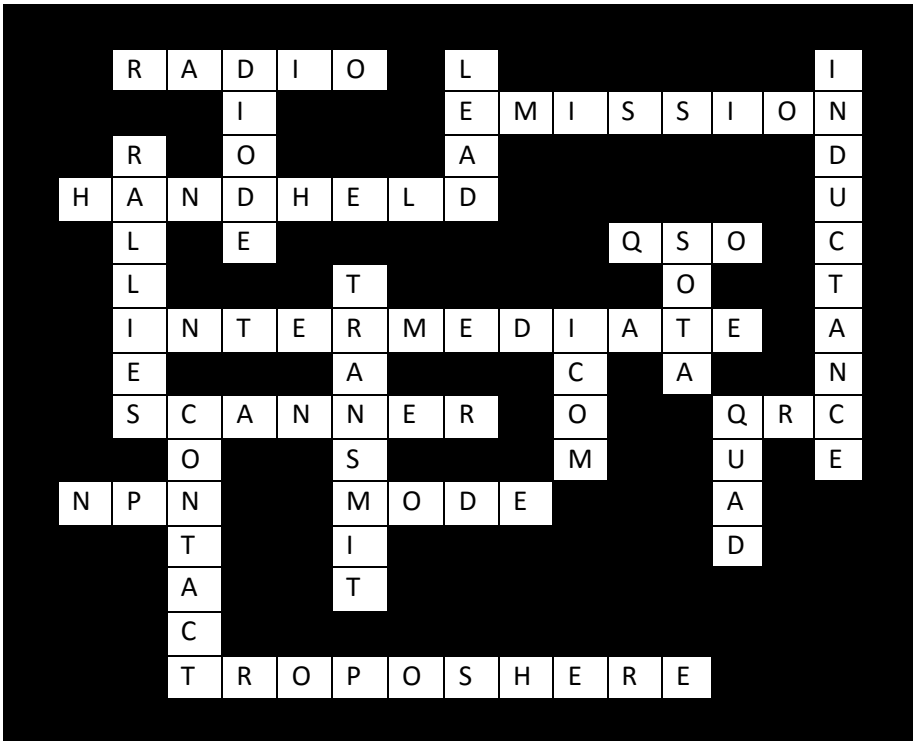
24 July Finningley ARS Rally
The Hurst Communications Centre, Belton Road, Sandtoft, Doncaster DN8 5SX.
Open 10:30. Free parking.
Contact: Kevin G3AAF, 07831-614640. Kevin@avery03.fsnet.co.uk

29 - 31 July AMSAT UK Colloquium [Friday - Sunday]
ChThe Holiday Inn, Edgerton Rd, Guildford, Surrey, GU2 7XZ.
Details: http://amsat-uk.org

31 July 2016 Horncastle Summer Rally
Horncastle Youth Centre, Horncastle, Lincs. LN9 6DZ.
Open 10:30. Admission £1.50.
Details: Tony Nightingale, G3ZPU, 01507-527835, tony.nightingale@yahoo.co.uk

Just a bit of fun

how did you do I last month's crossword? Here is the completed grid.



This Month, a quick dozen Anagrams, see how you do.
(2) Number in brackets is the number of words you are looking for.

Bridges Tour (1)
Area Aim Tudor (2)
Driftland Howso Spoil (2)
Tertials (1)
Legal Aid Orbit Idiom (3)
Confidential Ounce (2)
Usa Fuse Yoni (2)
Tab Pond (2)
Concrete Query Fun (2)
Mews Terr (2)
Tunic Cut In Rig (2)
Secretar Vin (1)

Your Committee

President	Tim Childe	G7TAC
Vice President	Nick Moss	G6DQN
Secretary	John Clark	M1EJG
Treasure	John Scott	G8UAE
Committee Members		
	Wayne Mocroft	M5LLT
	Geoff Cooper	G0KVK
	Mark Cadman	M0TCG
	Keith Dixon	M0HPY
	Ross Lewis	M6RLZ

And Finally

My thanks to Adrian (G0NLA), Bob(G4XOM) Wayne (M5LLT), RAOTA and Philip Cadman (G4JCP) for allowing us to use their article and Karen Clatworthy for the help in compiling this month Starlite.
Next month: Digital Voice Communication (part two) plus First Amateur Radio Callsigns

Peter Baker (2E0MVM) – Starlite Editor (editor@g6oi.org.uk)