

5MHz Experiment

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Chairman RSGB 5MHz Working Group

<http://www.rsgb-spectrumforum.org.uk/5MHz.htm>

5MHz in the UK

- Amateur access to 5MHz channels from mid-2002 to mid-2006
- Purpose to conduct experiments in
 - Emergency comms
 - Aerials
 - Propagation
- 5MHz Working Group (5WG) formed in Nov 2002.

Although not directly involved in seeking access to the 5MHz channels I was one of the members of the RSGB HF Committee, and thus was aware of the discussions that lead to UK amateurs gaining access to the channels.

The first major publicity for the 5MHz channels was in the September 2002 edition of RadCom, where the term, the Fivemegs experiment was coined. Whilst the emergency comms aspect of experimenting on 5MHz was developing well, more work was needed in particular to define better the more scientific aspects of possible experiments that could be carried out centrally. Thus, during and after September 2002 the HF Committee set up a Working Group to undertake this work, and as a member of the HF Committee, without any particular previous involvement in the 5MHz project I volunteered to take on the chairmanship of the Group.

5WG Membership

J W Gould, G3WKL, Chairman
G L Adams, G3LEQ (IARU Emergency Communications Region 1 Coordinator)
L W Barclay, G3HTF
P Gaskell, G4MWO (RSGB RCVS National Coordinator)
P Martinez, G3PLX
G Mossop, G0DUB (RAYNET representative)
C Thomas, G3PSM (Board Member, RSGB Spectrum Forum Manager, RSGB HF Manager)
M Wood, G7VRT (Cadet Representative & Liaison)
G Williams, G4FKH (RSGB Propagation Studies Committee)

The 5MHz Working Group, or for shorthand 5WG as it has become known, comprises the above members. Initially, Alan Betts, represented the RadioCommunications Agency. On the move of the latter organisation into Ofcom Alan resigned from the 5WG so that he could better act as the point of contact of the Working Group, within Ofcom, and our liaison link to MoD.

The 5WG is a valuable mix of expertise. We have some members whose role is to provide expert advice on topics such as propagation, and others who provide links to, or represent, organisations involved in the experimental use of the channels. Others, provide both advice and a “hands-on” effort.

5WG Remit

To deal with all matters concerning the temporary 5 MHz spot frequencies allocated to the Amateur Radio Service within the United Kingdom on a Notice of Variation basis.

The Group will formulate and monitor experiments and communications exercises in line with the terms of the Notice of Variation, and at periods to be agreed, report relevant findings to the Primary User via the Radiocommunications Agency.

This is a “cut down” version of our Terms of Reference. Note that the RadioCommunications Agency has now been replaced by Ofcom.

5WG achievements & ongoing work

- Coordinated scientific and emergency comms activities, reporting twice to RSGB Board, RA/Ofcom and MoD.
- Assess and make recommendations to Ofcom re NoV applications.
- Liaised and support given to individuals on their own experiments.
- Defined and coordinated a centrally run task, termed the “5MHz Experiment”
 - Commissioned and setup GB3RAL, 30th April 2004
 - Commissioned GB3WES late October 2004
 - Setup “consolidated log database” & publicised initial findings in RadCom Sept 2003

Most of the work of the 5WG is carried out by e-mail though a dedicated reflector. We have met once when it was judged the best way to clear the WG’s business, at other times we have successfully cleared outstanding business via a telephone conference call. We find these ways of working effective, efficient in terms of our time and importantly relatively inexpensive.

In making this presentation at HFC2004, I purposely omitted saying much about the good work that is being done in terms of experimenting with the use of HF in the support of emergency comms. It’s not a subject that I am personally involved in and thus don’t feel competent to discuss in any depth. That doesn’t mean that it isn’t an important part of our use of 5MHz, but just that I will concentrate for this presentation on the things that I am more personally involved.

5MHz Expt: Overview

- An data collection task run by the 5WG to allow later analysis
- Data is restricted to certain broad categories to keep the number of variables down
- A strict reporting format is specified
- Goals:
 - Creation of an empirical equation for 5MHz propagation
 - Creation of a large database that anyone can subsequently analyse to research things that might include
 - Effects of different categories of aerial type
 - Long-term noise-floor changes

In this slide and the next few that follow I will try and explain what the “experiment” is about. To differentiate this specific subject from the many other experiments that the 5WG hope that amateurs using their NoVs will define, I am going to use the term “5MHz Experiment” or 5MHz Expt” for short.

Fundamentally, the centrally coordinated experiment is one of collecting as much data as is possible, with an eventual aim of making it available to all for subsequent analysis. This is rather unusual, as with many scientific experiments one generally has a hypothesis that one then designs an experiment to help prove. Some will know of the discipline in science and engineering termed “design of experiments”. However, doing the science the other way around isn’t wrong, it’s just different, and possibly requires more care to ensure that enough data of the right type is collected. The 5WG also felt that it made sense to build upon the design of the Fivemegs experiment, from which this definition took over.

5MHz Expt: Log database

- 6151 separate entries in the Station Log & 6619 entries in the automatic beacon monitoring log
- All paper and e-mailed logs included, apart from
 - 7 with some data errors
 - 10 paper logs
- 360 different calls in the log
 - 2121 reports of GB3RAL
 - 79 stations logged more than 10 times
 - 11 stations logged more than 50 times
- Current issues
 - Data cleanup, e.g. typing & logging errors
 - Missing data, e.g. QTH Locator data

This set of statistics is drawn from the current database which now contains all but about 17 logs. There are 10 paper logs awaiting keying and 7 logs in the “hospital” – they have some peculiarities with the data that requires a little work before they can be added to the database.

Data cleanup is an issue – some of the problems are simple keying errors, some are logging errors, i.e. operators not hearing QTH locators or callsigns correctly. Most of the logging errors, e.g. aerial types, additional information, etc, were taken out from the data during the process of uploading it into the database.

You can see from the data that already the logging of the beacon has quickly outstripped that of individual QSOs. We need to do more to increase the latter, but not at the expense of reduced beacon reports!

5MHz Expt: Stations Heard/Worked

G3ENI	293	G3JFS	38
G3ZUN	239	G3SET	37
G3ENO	134	G3LEQ	35
G3GHS	111	G3KTH	33
G3DVK	94	G3BPM	33
G0HNW	84	GI4VIV	32
G4JNT	63	G3PLX	31
GW0VMZ	61	G0DUB	30
G0MRL	58	MM1RAH	28
G0UOO	51	G4KUJ	26
G5BM	51		
G8ABB	49		
G3JKD	43		
M0AFJ	40		

This is the “honour role” of top few stations that have been logged on the 5MHz channels. I suspect that there are more logs out there that could be incorporated into the database, which might make this table change somewhat.

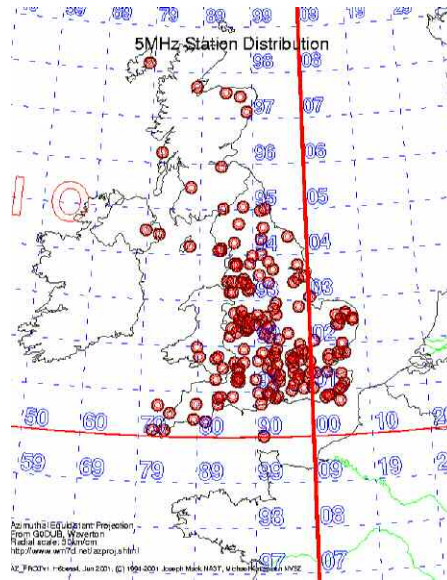
5MHz Expt: Stations submitting logs

2E0RGO / M3RGO	1947
G3ZUN	413
G3ENI	374
G8ABB	258
G3JNB	251
G4FKH	250
G3BPM	231
G3DVK	166
G8SAU	166
G0WTV	160
G3NPF	140
G3SET	137

This is the “honour role” of the top stations that have submitted logs.

My congratulations go to Max 2E0RGO, formerly M3RGO, who has submitted many manual reports of activity on the channels – and Max is acting as a SWL as until he makes his advance licence he doesn’t qualify to apply for an NoV to transmit!

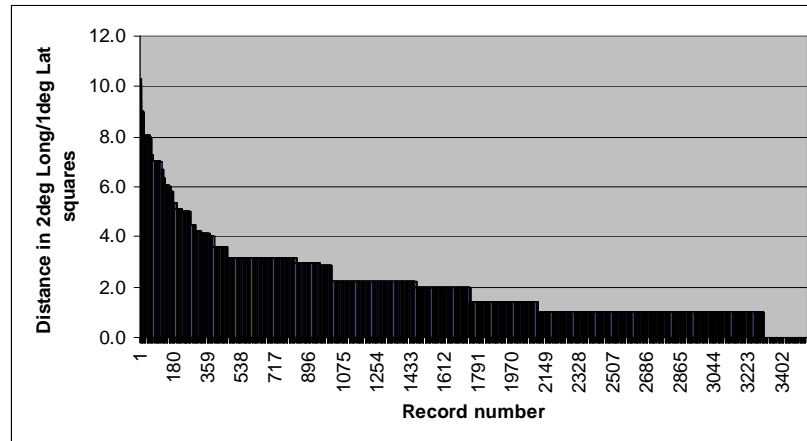
5MHz Expt: Station Distribution



This is the latest distribution of stations transmitting on the channels. Note the occasional “wet” locations, due as mentioned previously to data errors awaiting “clean-up”!

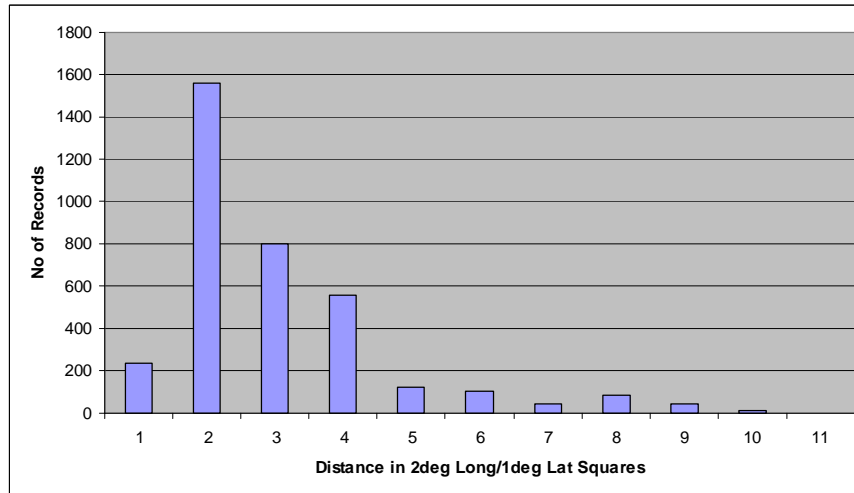
The distribution is not unsurprising, as it largely follows the population density distribution across the UK.

5MHz Expt: Path-length Distribution



The above histogram shows the distribution of contacts logged in the database. The vertical axis is the number of “squares” that the stations are apart. Work on automatically converting QTH locators to lat and long, so that distance in km or miles can be computed, is underway. As an interim measure I chose to simply calculate the distance between stations in 2deg longitude and 1deg latitude “squares”. The histogram was produced by ordering these distances.

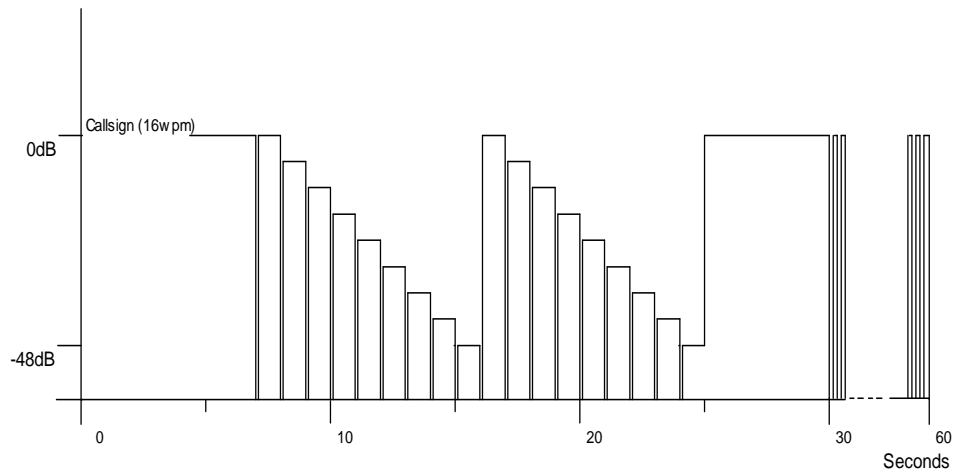
5MHz Expt: Path-length Histogram



This is a cut of the same data as the previous histogram, except that here the number of records (QSOs) being under 1 square, between 1 and 2 squares, etc, apart are graphed.

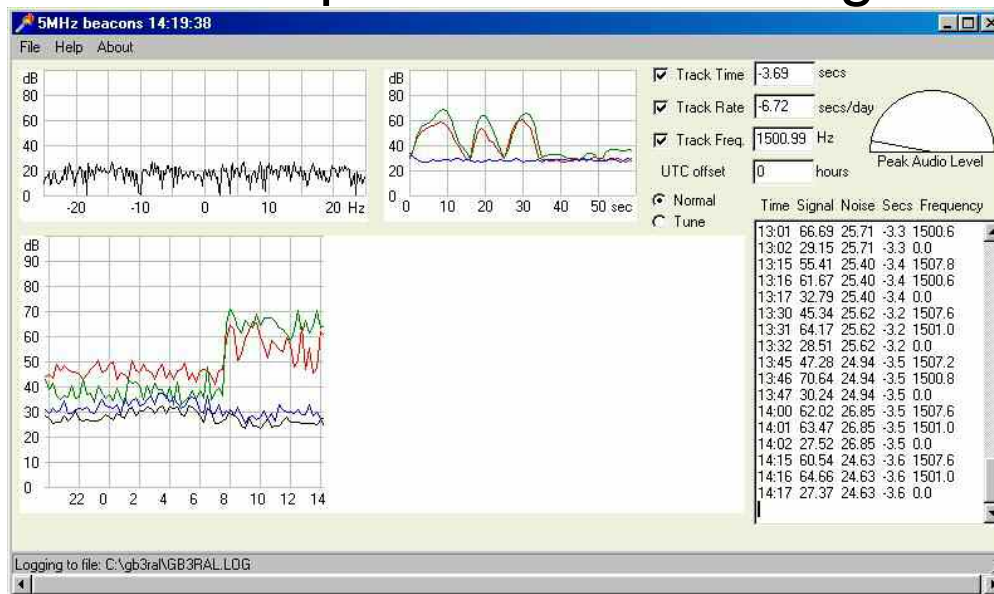
As expected, partly because of NVIS performance at 5MHz and the density of NoV transmissions, there are a lot of stations working over 2 or 3 “squares”. Interestingly, it would appear that there is also a small peak occurring at 8 squares. We will need to investigate this further, but it may be a fluke of the relatively small amount of data currently being used, or a specific regular QSO being logged.

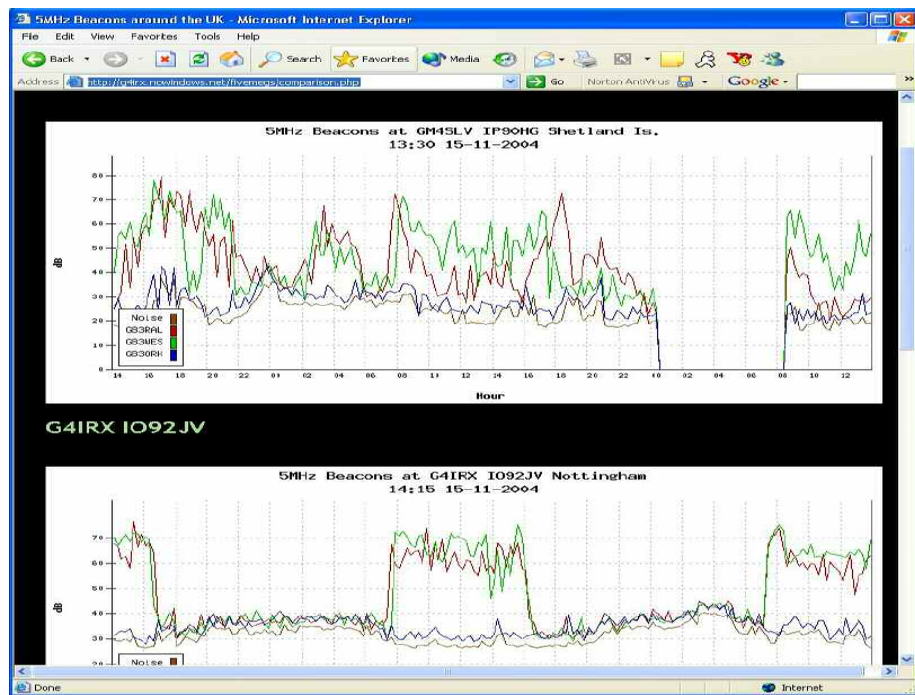
5MHz Expt: Beacon sequence



This is a diagrammatic representation of the keying sequence used by the beacons. It is actually the sequence for the two new beacons, GB3WES and GB3ORK as unlike GB3RAL they have 100mS periods at zero carrier between each step, to help differentiate the steps better.

5MHz Expt: Auto-monitoring





<http://g4irx.nowindows.net/fivemegs/comparison.php>

5MHz Expt: Work in progress

- Log Database
 - Data cleanup
 - Import mechanism for data from G3PLX's beacon monitor software
 - Auto-compute path-length from QTH Locators
 - Report on the statistics of the data
 - Consider how to make it available to all
- Beacons
 - Install and commission GB3ORK
 - Update monitoring / reporting information
 - Consider issues re. companion beacons at 3.5 and 7MHz.
- Analysis
 - Prepare detailed plans for creating a 5MHz propagation model

Probably the key task above is to create a simple loader routine to take the data that is produced by Peter Martinez's monitoring programme straight into the database.

5MHz Expt: Propagation model

Imagine a “mathematical” model that might contains the

$$\text{Quality of link} = \text{function } \{A(\text{Date}) + B(\text{Time}) + C(\text{Solar Flux}) + \\ D(\text{distance}) + E(\text{aerial}) + F(\text{orientation}) + G(\text{SINPO}) + \\ H(\text{Power}) + I(\text{mode})\}$$

The “problem” is to represent the coefficients (A, B, C etc) in the right way, and then solve for their numerical values by comparing the “model” with the data in the log database.

Firstly, a health warning that the equation presented here is not intended to be in any way a mathematical equation. It's intended to be a representation saying that the quality of a link between two stations, at certain locations in the UK might be expressed by an equation whereby date, time, solar flux, distance, aerial type/orientation, power and mode, etc, will have an effect. The quality will also have with it a specific SINPO type of characteristic.

This part of the “5MHz Expt” is more of a personal contribution within my 5WG role, as the Working Group would really prefer that individuals, or groups of amateurs, decide and carry out their own analysis of the Station Log data that we are collecting. Thus, this particular part of the experiment is a more personal contribution, which will involve some advanced mathematical and radio propagation treatment. To move forward on this particular aspect of the experiment contact has been made with several UK universities with the view of breaking up this analysis task into a series of research projects that electronic engineering and mathematics research students would undertake as projects within their work for their higher degrees. I hope in a few months to be able to make some clear announcements on this aspects of the work, but we are looking to the 2005 academic year for the research projects to be undertaken.

Final Comments

Recently the MoD have reminded us that we need to be careful to use our access to 5MHz for the conduct of experiments, and not merely to use the channels for general amateur usage.

You are all therefore encouraged to do just that by

- Creating your own experiments and publishing the results.
- Making sure that your logs are of use to someone.
- Participating with the 5MHz Experiment, either by collecting data and/or later carrying out some detailed analysis.

<http://www.rsgb-spectrumforum.org.uk/5MHz.htm>

To close, a slight caution for us all. The MoD, who have granted us this privileged right to use the 5MHz channels for experimental purposes do maintain an interest in how we conduct ourselves. Official monitoring of our use of the channels does take place so it is a responsibility of us all to conduct our experiments well and make good use of the frequencies whilst we have access to them.

We now need more activity and more logs to be submitted