International Amateur Radio Union Region 1

Europe, Middle East, Africa and Northern Asia Founded 1950

General Conference, Davos, 11 to 16 September 2005

SUBJECT	Definition of Modes: NBFM		
Society	SARL	Country:	South Africa
Committee:	C5	Paper number:	17
Contact:	John Fielding	e-mail:	johnf@futurenet.co.za

INTRODUCTION

As confusion now arises due to the choice of the original definitions it is felt that some amendments need to be made to the Handbook.

For equipment primarily intended for voice or speech transmission using frequency modulation it is proposed to encourage all to use the definition headings as published *Frequency Modulated Telephony*.

A.1. Frequency Modulated Telephony

"NBFM" is currently used to imply the above heading. The original intention was to distinguish between other modes when frequency modulation is used, i.e. for repeaters and simplex operation in the channelled segment of the bands. Packet Radio transmissions, although utilising narrow band frequency modulation, use audio tones to signify the mark and space bits of the data to be transmitted. It is felt that it would be more correct to refer to normal repeaters (i.e. those intended for telephony rather than data) as "Speech" or "Voice". As a mixture of transmission modes are now becoming common, e.g. A.P.R.S. which although primarily uses speech but also uses AX25 Packet Protocol for position reporting, it is necessary to make allowances for these new operating features. Packet Radio or speech (more correctly called *Frequency Modulated Telephony* - as used in doc. VIa) are both valid users of NBFM.

It is therefore proposed that the mode descriptor shall indicate the primary mode used. If the system uses speech and data in equal proportions the mode shall indicate which is the intended primary mode - a difficult point to clarify at present!

The problem is that the original recommendation sought to specify what the IARU Region 1 standard should be for amateur frequency modulated telephony and, as narrow band frequency modulation was identified as the preferred mode, it was named as "NBFM". Whereas the original specification was completely correct, many other forms of *NBFM* now exist today.

Originally it was intended to identify between the older 25kHz channel spacing equipment which used 5kHz deviation, sometimes called *WBFM*, and the newer 12.5kHz channel spacing being used by commercial users. NBFM has become a de-facto standard to be used by amateurs in the European countries of IARU Region 1 in order to conserve spectrum and quite rightly so. Several narrower types of NBFM have been in common use since the original specification was raised. In the UK a channel spacing of 6.25 kHz and 3.125 kHz was proposed in the 1970s and several manufacturers developed equipment for this application. More recently NATO military equipment manufacturers have adopted a channel spacing of 8.33kHz (being 1/3rd that of the 25kHz equipment currently used) with a maximum deviation of 2kHz, this is also "NBFM" but a little more NB than the original system!

The problem is that "NBFM" is a relative statement. 25kHz equipment also can be considered to be NBFM when compared to the older 100kHz and 50kHz channel spaced two-way radio equipment, or broadcasting standards that use 75kHz deviation and occupy a bandwidth of up to 200kHz. (See the information paper "*Practicalities of channel spacing and occupied bandwidth*" for more information).

The actual problem is that most amateurs have incorrectly used the term "NBFM" to mean "*FM speech transmissions*." This has led to an ongoing problem and the original meaning of the definition has been lost because of a widespread misunderstanding of the meaning of "NBFM".

Incidentally the 12kHz IF bandwidth mentioned in section A.1.a is incorrect. FM two-way radio equipment using 25kHz channel spacing typically uses an IF bandwidth of 15kHz with a maximum deviation of 5kHz. 12.5kHz channel spacing equipment hence typically uses a 7.5kHz IF bandwidth and this is entirely adequate for a deviation of 2.25 kHz with a maximum audio frequency of 2.25 kHz, which is the international standard.

The occupied bandwidth of a frequency-modulated transmission is given by Carson's Rule, which is:

$$B = 2\,(\Delta F + Mf)$$

Where:

ΔF is the peak deviation and Mf is the modulating frequency (audio).

For a peak deviation of 5kHz and a maximum audio frequency of 2.5kHz the required bandwidth is 15kHz and therefore the receiver IF bandwidth needs to be the same value to allow the signal to pass through with minimal distortion.

The 12.5kHz channel spaced equipment gives an occupied bandwidth of:

$$B = 2\,(2.25 + 2.25) \qquad = 9\text{kHz}$$

Which is too wide for the standard 7.5kHz IF filter. In this case the maximum audio frequency or the peak deviation need to be reduced to keep within the accepted bandwidth. If ΔF and Mf are both reduced to approx. 2kHz the occupied bandwidth will just pass through a standard 7.5kHz IF bandwidth with little distortion being introduced.

The IARU Region 1 standard for NBFM is a peak deviation of 3kHz and a maximum modulating frequency of 3kHz, this hence gives an occupied bandwidth of 12kHz and the receiver IF filter needs to be at least this wide to provide low distortion reception. This 12kHz IF bandwidth standard is neither one standard or another. It is a throwback to the older generation of 20kHz channel spaced two-way radio equipment and has not been used for many years by commercial two-way radio manufacturers. The European standards are 12.5kHz and 25kHz.

CONCLUSION

To get back to the original spirit of the Technical Recommendations it is proposed that we should stop referring to "NBFM" and simply call it "FM" with the original specification as used in doc. VIa. Similarly we need to amend the second section (A.1.b) from "NBFM Repeaters" to "FM Telephony Repeaters" to correctly reflect the meaning intended.