WATTS 02 - 2009

Year 79 +2m

Monthly newsletter of the Pretoria Amateur Radio Club
Maandelikse nuusbrief van die Pretoria Amateur Radio Klub.

PARC, PO Box 73696 Lynnwood Ridge 0040, RSA

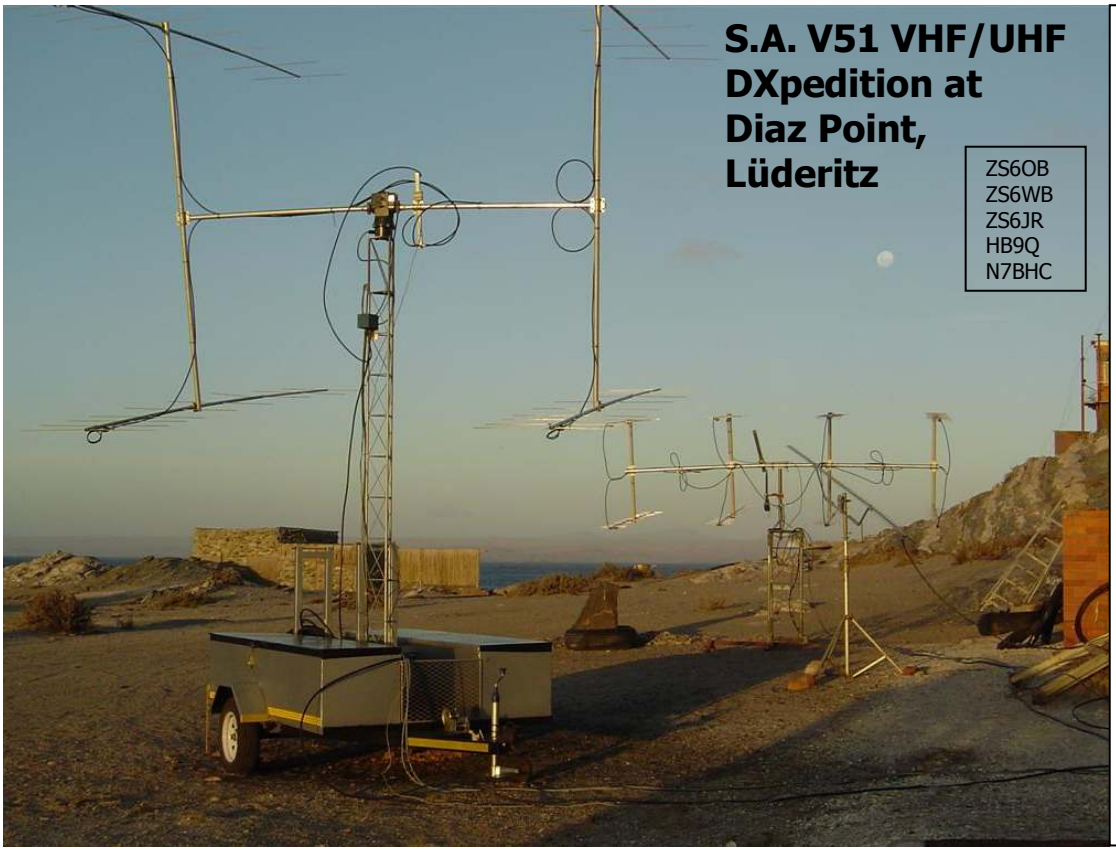
web http://www.parc.org.za mail:zs6pta@zs6pta.org.za

Bulletins :145,725MHz 08:45 Sundays / Sondae
Relays : 1840, 3700, 7066, 10135, 14235, 51400, 438825, 1297000kHz
Activated frequencies are announced prior to bulletins
Swapshop:Live on-air after bulletin 2m and 40m
Bulletin repeats | herhalings : Mondays 19:45 on 145,725 MHz

ZR6FD logo

Drukwerk printing ZS6JPL

Papier / Paper ZS6JPL



S.A. V51 VHF/UHF DXpedition at Diaz Point, Lüderitz

ZS6OB
ZS6WB
ZS6JR
HB9Q
N7BHC

View of antenna and support hardware overlooking the Atlantic Ocean coast.

Note the moonrise and the 2m and 70cm arrays pointing toward it. In between is a 1296 MHz yagi.

Regular expedition reports are recorded on the SARL VHF forum.

Google Dan's HB9Q (CRQ) website for full statistics of contacts.

In this issue / In hierdie uitgawe

Next Meeting
14 Feb 2009

Time: 13:30 for 14:00
PARC Clubhouse
South Campus
University of Pretoria
SE cnr University and
Lynnwood roads

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Minutes of the monthly club meeting of the Pretoria Amateur Radio Club held at the South Campus of the University of Pretoria on 14 Jan. 2009

Welcome: The chairman welcomed all present.
Present: See register, 13 members and no visitors.
Apologies: 11 as per register

Personal: Mike ZS6AFG is recuperating at home, Molly ZR6MOL is in Vista clinic. Jack ZS6QA is hospital. Alméro ZS6LDP is going in for a small ear procedure. Graham ZR6GJR fell off a horse. Sarel ZS6AC is suffering loss of sight. Doréén ZR6DDB has the sniffles.

Minutes: The minutes of the previous meeting were accepted. Proposed by Alméro ZS6LDP and seconded by Charel ZR6GN.
Matters Arising: None.

Finances: R500 was received from Johan ZS6JHB for the Namibian DXpedition, this and the R1500 previously approved was forwarded to the expedition. R1200 was received from the rally repeater and R100 in subscriptions. The balance in the current account is now R2621.78 and R128 in cash.

Rallies: Johan ZS6JHB reported that the Belfast regional rally is on 28 February.
Fox Hunts: The fox hunt will now be held on Sunday 25 January. A bring and braai will take place afterwards.
Flea Market: The next PARC flea market will 7 March at the PMC premises.
Social: Thanks to Brian for manning the drinks during the committee meeting. A social bring and braai will take place after the February meeting.

Talks: Signer ZS6SIG will talk at the February meeting and Hans ZS6KR has a video for the March meeting.

Contests: The HF field day takes place on 14/15 February unless amended by SARL who have requested comment on the date. The Pears national contest is 16/18 January.

Next meeting: The next meeting will be Saturday, February 14, 2009 at 14:00 followed by a bring and braai.

General: Hans ZS6KR is working to keep 10 and 15 meters alive. The meeting closed at 20:25

Editorial

The Namibian DX-pedition has come to a successful end despite Murphy having interfered at regular intervals after arrival at Luderitz. Hearty congratulations to Pine ZS6OB, Hal ZS6WB, Dan HB9CRQ, Daniel ZS6JR and Dave N7BHC for persevering with some equipment failure, antenna damage, strong winds and power problems. The full story is available on the SARL VHF/UHF Forum where regular reports were posted. Useful experiences gained will now be applied to future ventures in other parts of Southern Africa.

Redaksioneel

Die Namibiese DX-pedisie het suksesvol geeindig desondanks Murphy se gereëlde inmenging na aankoms in Luderitz. Hartlike gelukwense aan Pine ZS6OB, Hal ZS6WB, Dan HB9CRQ, Daniel ZS6JR en Dave N7BHC vir hulle volharding met die onklaar raak van party apparaat, antenna-skade, sterk wind en probleme met kragvoorsiening. Die volle verhaal is beskikbaar op die SARL VHF/UHF Forum waar gereëlde verslae gepos is. Nuttige ondervinding is bekom en sal nou toegepas word by toekomstige ondernemings in Suidelike Afrika.

Birthdays Feb
Verjaarsdae

03 Willie ZR6WGR
03 Aletta, LV van Alf ZS6ABA
03 Nico ZS6AQ
06 Ellen, LV van Joe ZS6AIC
09 David, seun van Ellen en Joe ZS6AIC
09 Kenny ZS6KMM
10 Paddy, SW of Kenny ZS6KMM
11 Leanne, SW of Allan ZS6AVC
12 Yvette, daughter of Rika and Errol ZR6VDR
15 Phil, SW of Craig ZS6RH
16 Pat ZR6AVC, SW of Frank ZS6GE
17 Freddie ZS6JC
20 Ivo ZS6AXT
22 Christopher, son of Joey and Graham ZR6GJR
23 Arrie ZS6IRA
23 Peter ZS6PJ

Anniversaries Feb
Herdenkings

03 Heather and Vince ZS6BTY (19)
18 Sarina en Willie ZR6WGR (9)
27 Paddy and Kenny ZS6KMM (44)
28 Phil and Craig ZS6RH (?)

Joys and Sorrows | Lief en Leed

- **Ivan ZS6AUT** is very ill and reportedly not improving.
- **Doppies ZS6BAQ** en **Henk ZS6CS** is altwee weer goed op die been.
- **Molly ZR6MOL** was in Vista Clinic for a while.
- **Almero ZS6LDP** went for a minor ear operation.
- **Graham ZR6GJR** fell off a horse and is a bit worse for wear.
- **Sarel ZS6AC** het ernstige sigprobleme wat nou behandel word.
- **Jac ZS6QA** started the new year in hospital but is home now.

Stan ZS6SDZ Silent Key

Our long-standing member Stan Zway passed away peacefully during the night of 23 January.
The club extends its sincerest condolences to his family and friends.
Despite his disability he was always his cheerful self and a wonderful friend to the amateur community.

Diary | Dagboek (UTC times)

Jan	31	Last day for submissions of SARL AGM motions
Feb	**14**	**PARC Club meeting Saturday afternoon 2pm**
	14-15	CQWW WPX RTTY Contest 00:00-23:59
	14-15	Dutch PACC Contest CW/SSB 12:00-12:00
	14-15	RSGB 1.8MHz Contest CW 21:00-01:00
	15	Last day for submissions for Tinus Lange 7066 Tech Excellence award
	18	Moon Contest CW/Digi/SSB 19:00-21:00
	21-22	ARRL International CW DX Contest 00:00-24:00
	21-22	REF Contest SSB 06:00-18:00
	27-28	Russian PSK31 WW Contest 21:00-21:00
	27-01	CQ WW 160m Contest SSB 22:00-22:00
	28-01	UBA DX Contest SSB 13:00-13:00
Feb/Ma		**PARC Fleamarket 8am. Date and venue to be confirmed.**

Rally Calendar

SA NATIONAL RALLY CHAMPIONSHIPS

25 Apr	**Sasol Mpumalanga**
23 May	**SCC Ermelo**
24 Oct	**Toyota Gauteng**

NATIONAL OFF-ROAD

3 Oct	**TD400**

Snippets | Brokkies

- **Ed ZS6UT** picked up a **Marconi marine Morse key used on the S.A. Agulhas** during early SANAE trips. →

Ivan ZS6CC in festive mood in Kiev. He is now T/OK1LL. Various pictures were received by your editor from sw Vlasta showing views of the city.

Wi-Fi networks now cover large parts of Gauteng, Cape Town

Submitted by Roy ZS6MI – an active user

MyBroadband recently reported on the strong growth of community networks using standard Wi-Fi equipment to connect members to each other. In December the combined Gauteng networks - i.e. JAWUG, PTAWUG and PWP – had in the region of 350 connected members.

In December the Pretoria Wireless User Group (PTAWUG), which forms part of the Gauteng Community Network, estimated that it would grow its 187 member network to 200 by February 2009.

The growth over the last two months has however surpassed expectations. The PTAWUG now has 227 connected members, far exceeding their expectations just two months ago. The combined number of connected members on the Gauteng Community Network now exceeds 400, and spans from the South of Johannesburg to the North of Pretoria.

According to PTAWUG organizer Dawie Joubert, aka Protzkrog, they are planning a third link between the Pretoria and Jhb network which will strengthen ties between these two groups and ultimately lead to a provincial Gauteng Network (GAUWUG).

The Gauteng networks are however not the only community networks in South Africa. The Cape Town Wireless User Group currently has 107 active users connected to their network. It boasts 6 major high sites and multiple relay nodes where users can connect.

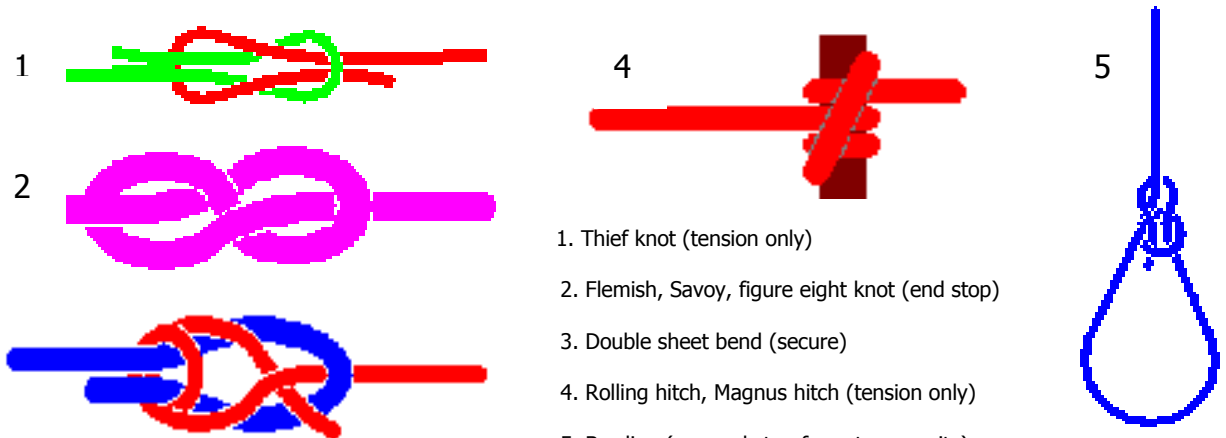
The Cape Town network spans from Wynberg in the South to Kraaifontein in the North and runs on the OSPF routing protocol ensuring redundancy is there when needed.

Durban, Bloemfontein and Port Elizabeth also all have well established community networks while East London is one of the latest cities to join this group with a network which already covers large parts of the seaside metro.

Apart from sharing content like Linux distributions and other free software, these networks have also become popular for gaming and VoIP. As there are no bandwidth charges and associated costs it becomes an attractive alternative to using a traditional Internet connection for online gaming or file sharing using P2P systems.

Users interested in joining one of the wireless networks are encouraged to visit http://www.wug.za.net/ and contact their local group. Check out the 'getting started' page to see what is involved to be connected.

Knots for your guys, dipoles etc. (Many more on www.brigtn.mistral.co.uk/knots/42ktmenu.html)



1. Thief knot (tension only)
2. Flemish, Savoy, figure eight knot (end stop)
3. Double sheet bend (secure)
4. Rolling hitch, Magnus hitch (tension only)
5. Bowline (use end stop for extra security)

Long Term HF Propagation Prediction for Feb. 2009

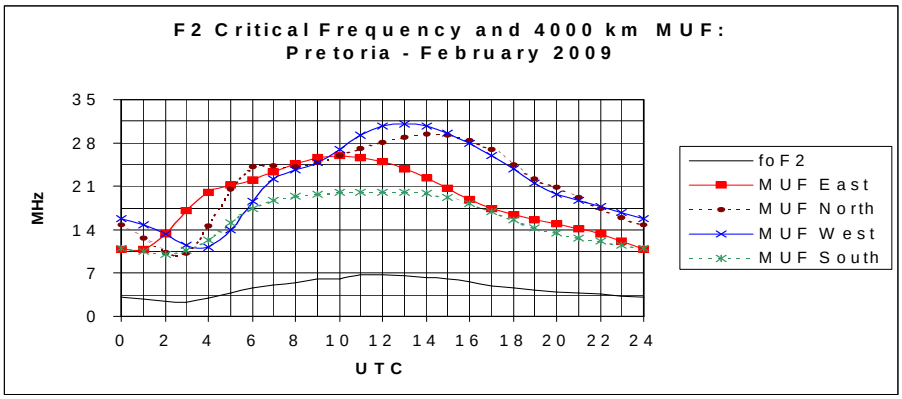
courtesy ZS6BTY

DX Operating

The graph shows the 4000 km maximum useable frequency (MUF) to the East, North, West and South from Pretoria for the first hop using the F2 layer.

Local Operating

The F2 critical frequency (foF2) is the maximum frequency that will reflect when you transmit straight up. E-layer reflection is not shown.



FM, Land-Mobile Radio and the Amateur Radio Service – a brief history

by Adam Farson VA7OJ/AB4OJ

Introduction

In this article, a brief overview of the underlying theory will show why FM is superior to amplitude-modulated emissions in the land and maritime mobile radio services above 30 MHz. A brief history of the evolution of these services, in civilian and military spheres, will follow. The impact of these developments on the Amateur Radio Service will also be discussed.

In keeping with the author's experience, developments in the United States will receive the most coverage, although European contributions (especially in the military arena) will also be discussed in some detail.

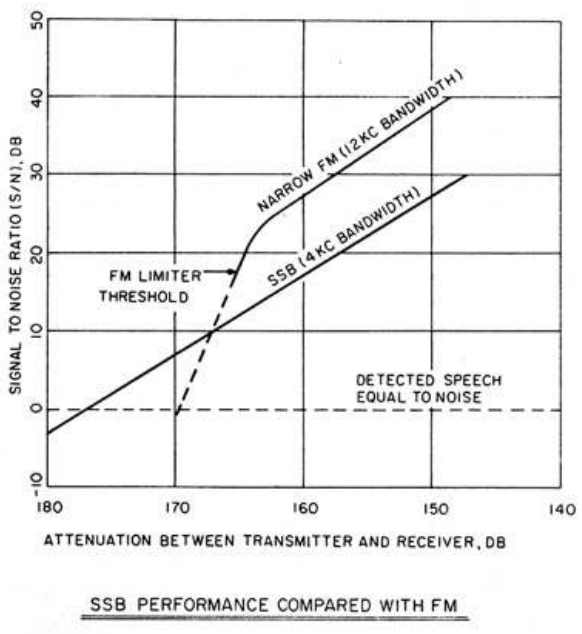
First, a bit of theory

A quick comparison of FM with SSB is interesting. Let us consider how path performance degrades with increasing path loss for each emission type. The curves in Fig.1 are illustrative:

It will be seen that SSB has a linear relationship between path loss and S/N (as does AM); there is no threshold "knee" as such. Modern DSP-based, heuristic noise-reduction (NR) techniques can often extract a usable baseband when the SSB signal is "down in the noise" (S/N < 3 dB). This has certainly been my experience with modern DSP-based HF transceivers, for example.

With FM, when the threshold is reached with increasing path loss, the S/N will degrade much more rapidly than for the SSB case, but intelligible voice audio is recoverable 3 to 6 dB below threshold - as long as incidental AM due to man-made noise is not too severe. Threshold-extension techniques (e.g. using a PLL demodulator with a loop filter cutting off at $\mathbf{f_m}$) can push the threshold back along the path-loss axis as much as 7 dB.

Fig.1: Simplified S/N vs. path loss curves for FM & SSB.



Important definitions:

FM modulation index $\mathbf{m = \Delta f / f_m}$ where $\mathbf{\Delta f}$ = peak deviation and $\mathbf{f_m}$ = highest modulating frequency.

Carson's rule: $\mathbf{TBW \sim 2 * (\Delta f + f_m)}$ where TBW = transmitted occupied bandwidth.

A characteristic of FM is that as **m** increases, the S/N above threshold will be higher for a given path loss, but the threshold "knee" moves to the right with increasing **m**. For **m** = 1 (typical in VHF or UHF FM systems with $\mathbf{\Delta f =}$ ±2.5 kHz and $\mathbf{f_m}$ = 2.5 kHz), the Carson's-rule occupied bandwidth is 2 (2.5 + 2.5) = 10 kHz. Compare this to 2.5 kHz occupied bandwidth for a typical SSB signal, which will be intelligible at path loss values well below the FM threshold.

Note that when path loss is sufficiently low to fully saturate the FM receiver's limiter (**full quieting**), S/N will be higher than for the same path loss value in the SSB case. (In the example shown in Fig. 1, this occurs at 150 to 160 dB path loss.) The reason for this is that AM noise which would be fully suppressed in the FM receiver will still appear in the SSB receiver's base-band output. Thus, if we can engineer our FM system for at least 10 dB of fade margin (headroom), overall path performance will exceed that of a comparable SSB (or AM) system.

Another advantage of FM is the **capture effect.** If two incident co-channel signals differ in amplitude by 6 dB or more, the FM receiver will capture the stronger signal and suppress the weaker. This confers greater immunity from accidental or intentional co-channel interference. Yet another factor favoring FM (as compared to AM) is that for a given transmitter output the primary power input is significantly less, as the high-level modulator stage is eliminated. This has obvious implications in mobile and portable radio designs.

These considerations drove the adoption of FM in land-mobile radio (LMR) as well as short-haul maritime R/T communications. Nowadays, virtually all short-range and inshore maritime radio communications are FM, in the 156-162 MHz range.

During the 1930s, mobile two-way radio communications systems came into use as technology made possible the design of transmitters which could be operated in vehicles. The advent of frequency modulation (FM) provided much clearer and less noisy transmissions, free from vehicular static. Almost all mobile systems operated below 40 MHz, since little was known about propagation at frequencies above that range, particularly in urban environments. However, research on the propagation of higher frequencies continued almost continuously from that time on.

The first significant FM LMR system was the Connecticut State Police low-band radio communications network, using sets designed and built by Daniel Noble and Fred M. Link. Soon, Noble joined Galvin Corporation (later Motorola). Galvin launched its own line of FM public-safety radio sets in approximately 1941.

The early successes of FM in US public-safety, local-government and commercial radio services led directly to the widespread deployment of 27 - 55 MHz FM tactical radio equipment in the US Army Signal Corps. To speed the adoption of FM, Edwin Armstrong freely licensed his FM patents to the US Government. By late 1943 to mid-1944, mobile and portable US-built FM sets, manufactured by Galvin, Link, RCA and others, were available to the US Army Signal Corps. Examples were the SCR-610 mobile and BC-1000 manpack. Transmitter power levels ranged from 0.5W or so for manpacks to 15W for mobiles. World War II demonstrated the superiority of FM transmission, which proved easier to use and more difficult to jam than the VHF AM systems in use by the Axis forces. Only U.S. forces used significant numbers of FM tactical ground radio systems.

Following WW II, many ex-servicemen returned to "civvy street" with a knowledge of radio technology and an appreciation of the value and convenience of mobile radio communications. Former military radiomen found ready and lucrative employment as maintenance technicians and installers serving the rapid growth of these new radio systems. Training courses for the coveted FCC Radiotelephone Operator's Licence (then required by law for LMR radio maintainers) sprang up in many cities, and were funded by veterans' education programs.

The late 1940s were equally important years for other aspects of mobile radio. AT&T introduced the first commercial public land mobile radio-telephone system in St. Louis in 1946. However, service was limited by a lack of channels, and the system was cumbersome to use, with half-duplex "push-to-talk" and manual connections via telephone-company "Mobile" operators. Nonetheless, 25 U.S. cities had public mobile telephone service by year's end. This system was termed MTS (Mobile Telephone Service).
As the demand for mobile telephony increased, the FCC assigned additional channels; IMTS (Improved MTS) supplanted MTS. IMTS featured up to 12 channels with automatic idle-channel selection, full-duplex working and direct subscriber dialing from the mobile as well as the fixed side. Analogue FM cellular service began to displace IMTS in the early 1980's.

Some surplus military radio equipment entered civilian life as low-band taxi dispatch radios, especially in New York and other cities. One should note, though, that ever more stringent FCC equipment certification requirements locked military surplus (except for military variants of previously-certified civilian radios) completely out of the LMR market by the early 1950's.

Development of specialized vacuum tubes with useful gain at VHF (some based on German designs), and the need to operate above the highest range of enemy intercept receivers, drove the development of 100 - 156 MHz AM air-to-air and ground-to-air radio.
Why AM rather than FM? Unlike FM, AM has no capture effect. This is vital in air-traffic control; if two aircraft are co-channel, the controller will be able to hear both. For this reason, 108-137 MHz (VHF) and 225 - 400 MHz (military UHF) use AM, not FM, to this day.
It should be noted here that during the war, several US law-enforcement agencies took advantage of the new high-band VHF technology by installing 118 MHz FM systems including mobile radios, and mountaintop links. After the war, the FCC allocated 30-50, 150-174 and 450-470 MHz (later expanded to 512 MHz) to LMR services, and reassigned the 118 MHz band to the aeronautical radio service.

Influence of LMR technology on the Amateur Radio Service (ARS)
Prior to, and immediately after WW II, all VHF R/T in the ARS was AM. For reasons which I have never fully understood, the immense advantages of FM over AM for local VHF/UHF radiotelephone communications were barely, if ever realized in the ARS until a US regulatory change in 1963 stood the whole thing on its head. The shift from AM to NBFM in the VHF bands started in the US. In 1963, the FCC mandated an occupied-bandwidth change in the LMR bands (30- 50, 150.8 - 174 and 450 - 470 MHz) from 36 kHz to 16 kHz. Channel spacings of 60 kHz (VHF) and 50 kHz (UHF) were halved; peak deviation was reduced from 15 to 5 kHz. Some existing sets could be "narrow-banded" by fitting narrower IF filters and turning down the deviation, but most were not economically modifiable. These sets were replaced with newer, narrow-band models, and the old sets found their way onto the surplus market. In no time at all, of course, enterprising hams had snapped them up and converted them to 2m and 70cm. A smaller number found their way onto 6m, which was never as popular due to TVI issues with VHF Channel 2 (54 - 60 MHz).

When the FCC authorized amateur repeaters shortly thereafter, amateur FM operation really took off as the popular mode par excellence, and all but eclipsed AM. Hams built repeaters out of mobiles, and also converted retired commercial base stations. As the number of amateur FM operators proliferated - especially in California and on the US Eastern Seaboard - the ARS also switched to 5 kHz peak deviation, where it remains to this day.

Innovative amateur groups built up extensive repeater networks, with multiple receiver sites and voters for optimum handheld coverage. Other groups, especially in the western states, engineered "intertie" networks linking repeaters and remote-controlled base stations via UHF-FM point-to-point links. Telephone-line interconnects, enabling a repeater user to place a call from his radio set to the public telephone network, were also provided where allowed (or at least tolerated) by telephone-company policy. These systems undoubtedly saved many lives. Most of this network deployment was accomplished using retired LMR equipment.
As the supply of surplus dried up, ham-equipment manufacturers started offering 6m, 2m and 70cm mobiles and handhelds, along with a few base-type radios. These were the progenitors of the modern, feature-laden dual- or multi-band FM mobile or handheld so popular among today's hams. Due to cost considerations, these wide-range multi-band sets do not have the front-end protection inherent to an LMR transceiver, and are thus subject to IMD and cross-modulation in high-RF areas. Thus, a demanding amateur will often prefer a "retired" LMR radio.

There is no doubt whatsoever that the huge increase in traffic on the 2m and 70cm amateur bands brought about by FM and repeaters has materially strengthened the argument for amateur retention of these bands. It is regrettable, though, that radio amateurs did not more exhaustively explore the benefits of threshold-extension demodulators for weak-signal FM working.

One of the most significant milestones was the release of surplus battery-operated portable FM equipment, especially handhelds, into the ham market. This equipment was hitherto unaffordable by hams.

Handhelds such as the famous Motorola HT-220 were the most reliable pieces of gear a ham could own; they also ushered in the era of personal portable communications in the ARS. The handheld/repeater combination revolutionized amateur emergency communications, putting them almost on a par with public-safety radio systems. In fact, many countries have integrated their national amateur radio societies into their emergency-planning operations, and for the first time ever (at WRC 2003) the ITU formally defined a disaster-communications role for the Amateur Radio Service.

Developments in Europe
Prior to WW II, the German and Dutch radio industries had discovered the virtues of line-of-sight propagation for urban mobile radio communications. This drove the deployment of VHF R/T systems in the 30 - 55 MHz band, and later (after WW II) in the 66 - 88 MHz band. The following statement from a pre-war German planning document is astounding: "Equipping *Panzer* troops with VHF radio enabled individual units to be tied into the command network. The control over fast-moving combat forces gave the *Wehrmacht* operational advantages." It has been said that tactical VHF radio was the "central nervous system" of the *Blitzkrieg,* as it facilitated the integrated command and control of infantry, armor and close air support. The German mobile VHF transmitters had 10 to 15W output; portables such as the *"Kleinfunksprecher D"* had 0.25 to 0.5W output, in the 30 - 55 MHz range.

Interestingly, two German airborne VHF radio sets – the FuG 15 (38 - 47 MHz) and the FuG 18 (24 -75 MHz) supported both AM and FM. These sets were developed in 1943-44. The FuG18 was a transceiver in the modern sense, with a common master oscillator and an up-converting transmitter. The reason for the inclusion of FM is unclear, but this mode may have been intended for use in *Funkspiel* (radio deception) operations against the RAF Ascension FM agent radio system[1], and perhaps even against US Army tactical VHF-FM nets after D-Day. *(In this connection, it is noteworthy that one of Edwin Armstrong's engineers absconded to Germany in 1941 with a full set of his employer's FM notes. He was never caught.)*

Manufacturers such as Siemens, Telefunken and Philips (Valvo in Germany) responded to this need with the surprisingly rapid development of suitable tubes. Some captured German VHF sets found their way to the US; Bell Labs received several of the excellent VHF tubes used in these sets. These designs gave rise to the famous "acorn" tube (e.g. 955) and frame-grid UHF tubes.

German successes with VHF tactical mobile radio in WW II fed directly into the deployment of such things as the 66 - 88 MHz FM LMR networks in post-war Germany. Examples are the national *Autobahnpolizei* network, and radio systems operated by urban public-transport agencies. In a manner paralleling developments in the US, European public and private entities adopted VHF FM land-mobile communications in the 66–88, 146-174 and 440-470 MHz bands starting in the 1950's. Manufacturers such as Pye (part of Philips after 1965), Storno, STC, Marconi and Motorola were the main equipment suppliers. As had occurred earlier in the US, the shift from 25 to 12.5 kHz channel spacing in the 1970's released significant quantities of LMR gear into the amateur community.

Military tactical VHF radio in the UK
In the British Army, the use of the VHF band (27-55 MHz) for tactical field radio was proposed during WW II, but there was considerable opposition to its use. This diffidence arose from entrenched use of ground-wave in the low HF range, uncertainties about VHF path performance in wooded or hilly country, and the requirement for sky-wave transmission on medium/long-haul circuits. The sky-wave requirement dominated the Army's radio-equipment policy until spectrum congestion, and severe night interference in the Far East, forced a re-examination of the problem.

Doubtless, a factor which accelerated the move to VHF was the considerable success attained first by German, and later by US Army forces in their use of the VHF band for infantry and armored formations, as well as for infantry/armor intercommunication. One should note that the British Army's gradual adoption of VHF came quite late in the war, and that they had German and US experience to build upon. It was nevertheless a bold venture, which ultimately succeeded. Even so, the British Army relied mainly on HF ground-wave, using low-powered sets in the 2 – 9 MHz range, right up to war's end. It did not fully commit to VHF FM until it standardized the WS88 FM manpack and the "Larkspur" radio family after WW II.

Recent trends
Ever-increasing pressure on available spectrum drove attempts to squeeze more channels into the available space, and also brought about major spectrum reallocations – mostly at the expense of the UHF TV bands, which were much less utilized than spectrum managers had anticipated when they were first assigned. In a few cases, under-used amateur spectrum was also reallocated – notably the 220-222 and 420-430 MHz ranges in Region 2. FM channel spacings were progressively reduced, first to 12.5 kHz, then to 6.25 kHz. At this narrow spacing, modulation index **m** < 1; thus the S/N advantage of FM over AM is almost lost.
An alternative modulation method, ACSB (amplitude-compandored SSB) was proposed and tested in field trials in the 1990's, but proved to be so susceptible to AM noise and interference that the user community ultimately rejected it in favour of FM.

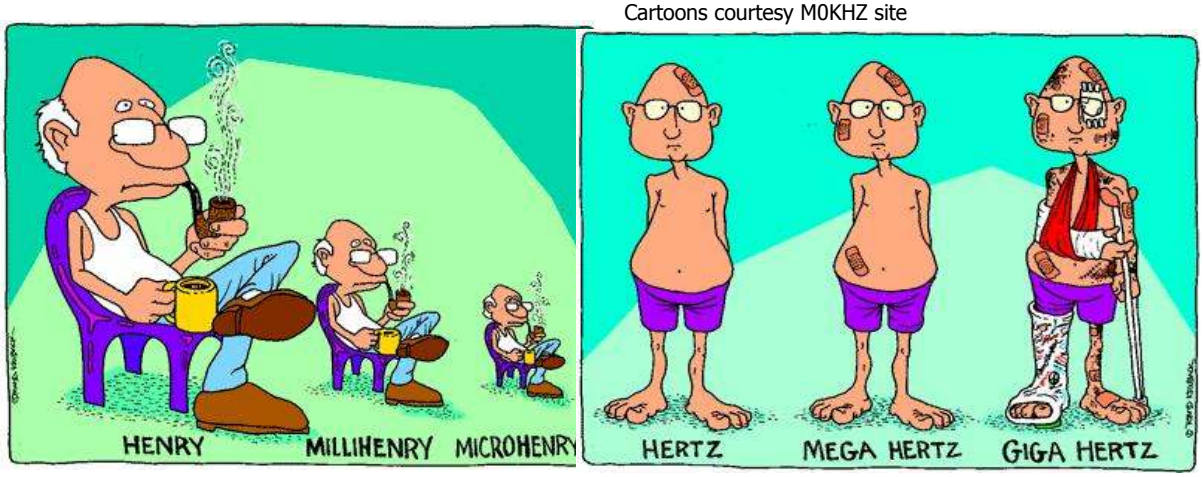
Various digital modulation systems have begun to take hold, especially in public-safety radio networks. In police and other local-government radio services, digital modulation methods are easily encrypted and can thus be made very secure. The major disadvantage of any digital modulation scheme is that the bit-error rate (BER) goes to infinity at the threshold; this causes loss of synchronization between the receiver and transmitter, destroying the link. To ensure acceptable fade margins, these systems must be engineered with a larger number of base stations and repeaters, and higher ERP.

So we finally come back to the "old standby", FM. It will still "get through" in a wide variety of topographical situations and equipment configurations, with relatively inexpensive equipment that is also easy to maintain and repair.

Acknowledgements
- *The author wishes to thank Brian Austin G0GSF for his invaluable assistance and constructive comments in researching and preparing this article.*
- *Source for Figure 1: "A First Primer describing SSB", TMC, 1960.*

[1] G. Pidgeon, "The Secret Wireless War", p. 100. UPSO 2003. Ascension may have been the only British use of FM during WW II.

Cartoons courtesy M0KHZ site



Jake is struggling through an airport terminal with two huge and obviously heavy suitcases when a stranger walks up to him and asks: "Have you got the time?"
Jake sighs, puts down the suitcases and glances at his wrist. "It's a quarter to six", he says.
"Hey, that's a pretty fancy watch!" exclaims the stranger.
Jake brightens a little. "Yeah, it's not bad. Check this out..." - and he shows him a time zone display not just for every time zone in the world, but for the 86 largest metropoli. He hits a few buttons and from somewhere on the watch a voice says "The time is eleven till six" in a very West Texas accent. A few more buttons and the same voice says something in Japanese. Jake continues "I've put in regional accents for each city. The display is unbelievably high quality and the voice is simply astounding." The stranger is struck dumb with admiration.
"That's not all...", says Jake. He pushes a few more buttons and a tiny but very hi-resolution map of New York City appears on the display. "The flashing dot shows our location by satellite positioning", explains Jake. "View recede ten", Jake says, and the display changes to show eastern New York state.
"I want to buy this watch!" says the stranger.
"Oh, no, it's not ready for sale yet; I'm still working out the bugs", says the inventor. "But look at this", and he proceeds to demonstrate that "the watch is also a very creditable little FM radio receiver with a digital tuner, a sonar device that can measure distances up to 125 meters, a pager with thermal paper printout and, most impressive of all, the capacity for voice recordings of up to 300 standard-size books, though I only have 32 of my favorites in there so far" says Jake.
"I've got to have this watch!" says the stranger.
"No, you don't understand; it's not ready."
"I'll give you $1000 for it!"
"Oh, no, I've already spent more than ..."
"I'll give you $5000 for it!"
"But it's just not ..."
"I'll give you $15,000 for it!" And the stranger pulls out a checkbook.
Jake stops to think. He's only put about $8,500 into materials and development, and with $15,000 he can make another one and have it ready for merchandising in only six months. The stranger frantically finishes writing the check and waves it in front of him.
"Here it is, ready to hand to you right here and now. $15,000. Take it or leave it."
Jake abruptly makes his decision. "OK", he says, and peels off the watch and hands it to the stranger.
They make the exchange and the stranger starts happily away.
"Hey, wait a minute", calls Jake after the stranger, who turns around warily. Jake points to the two suitcases he had been trying to wrestle through the terminal. "Don't forget your batteries."

An engineer, a physicist and a mathematicians have to build a fence around a flock of sheep, using as little material as possible.
The engineer forms the flock into a circular shape and constructs a fence around it.
The physicist builds a fence with an infinite diameter and pulls it together until it fits around the flock.
The mathematicians thinks for a while, then builds a fence around himself and defines himself as being outside.

A telphone man joined the Army. As part of his basic training, he went out on the rifle range.
He fired 99 shots at the target, and missed the target with every shot!
His Drill Instructor tried to find out why.
"What's the matter with you?" asked the DI.
"Why can't you hit the target?
What were you in civilian life?"
"I was a telephone man," replied the new recruit, "and I don't know why I can't hit the target.
Let me see..."
The telephone man checked his rifle, checked his rifle again, and checked his rifle a third time.
He then put his finger in front of the muzzle, pulled the trigger, and blew the end of his finger off!
"Well," the phone man said, writhing in pain, the bullets are leaving here fine.
The trouble must be on the other end!"