Headquarters - Info - Line

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The New Zealand Association of Radio Transmitters Incorporated

23rd March 2004 **Issue # 70**

Greetings Everyone,

Welcome to **Headquarters–Info-Line** a fortnightly bulletin of news from NZART Headquarters E-mailed directly to Branches.

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From The President Peter Norden ZL2SJ:

Council are pleased to announce the appointment of Noel Rowe ZL3GR to Council; Noel is a second term Councillor having served previously in the 90s. The casual vacancy was caused by the resignation of Ted Minchin ZL1MT, who resigned for personal reasons.

Another Council appointment is that of Joe Reed ZL2AH who volunteered to take on the tasks of Reciprocal Licence Bureau Manger from the late Russ Garlick ZL3AAA.

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NZART Business Manager Debby ZL2TDM Says:

I will be away - Due to a slight glitch in my health; I will be off work for approximately 4-6 weeks commencing with a routine operation on the 1st of April. Nothing to worry about, just have to have an overhaul as most equipment does when it reaches middle age! I will endeavour to write my usual blurb for HQ Info-line while recuperating.

The Office will be open from time to time, however I would suggest that you either call or perhaps contact the President Peter ZL2SJ on 06 308 6970, or e-mail zl2sj@nzart.org.nz for any urgent matters.

Final reminders…have now been sent out to all those who have yet to pay their 2004 subscription. Remember that in order to vote at the upcoming Conference in Blenheim, you must be a financial member of NZART.

Branch Circulars will be posted out to all Branch Secretaries on Monday 29th March. Please ensure you read the contents. I will be including an update for your Branch Listings for Call Book, Branch member voting figures for Conference and FMTAG Repeater and Beacon update forms for each Branch.

An Opportunity for Amateur Radio…International Museums Weekend will take place on the weekend of 19th-20th June 2004. Setting up an amateur radio station in a museum is a good way of showing amateur radio to the public, as well as good publicity for the museum. Further details can be had from Harry Broomfield M1BYT email harry.m1byt@tiscali.co.uk

See you in a few weeks.

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REPORT ON THE 12th CONFERENCE OF IARU REGION 3

16 - 20 February 2004, Taipei, Taiwan

Report from Peter Lake, ZL2AZ, NZART IARU Liaison Officer - The 12th IARU Region 3 Conference was held recently in Taipei, delayed from September 2003 due to the outbreak of SARS in Asia. The Chinese Taipei Amateur Radio League (CTARL) were the host society. In spite of changes of date and venue, and the economic situation in some countries, attendance and representation increased; although there were fewer input documents.

The NZART team consisted of Peter Norden ZL2SJ the NZART President as the "Delegate" (exercising our vote), and Observers Peter Lake ZL2AZ (IARU Liaison Officer) and Terry Carrell ZL3QL and John Lochhead ZL4QS (IARU Committee members). This was a blend of significant experience in Region 3 activities, and a "new trainee". John had not attended such a conference before. This is a vital part of our "succession planning". Note that these are not "open" conferences like our AGM, but have accredited Delegates with voting rights and Observers. Fred Johnson ZL2AMJ also attended (of course) as the Chairman of Directors of Region 3.

We know from experience that a strong team is needed on the ground, especially to cover the different Working Groups where the detailed work is done, over a wide range of subjects. A lot of discussion goes on "after hours" to debate issues and look for solutions to the problems that arise. NZART is an advanced society compared to some in Region 3 and with like Societies, has a major responsibility to develop amateur radio in the region. Our record of achievements and contributions has been much greater than our size alone suggests.

The team worked hard and made a significant contribution to the success of the Conference. Early starts and late finishes were required, especially on the Working Group reports. Little of Taipei was seen during the conference week, even at lunch breaks.

Our preparations and preliminary analysis of all the papers, the quality of our input papers, and our previous experience due to the stability of our IARU Liaison team was evident. Our recommendations were adopted in nearly all cases. We contributed to the debates, chairing and leading groups, and provided scribe assistance.

Some difficult constitutional and policy issues took up a lot of time, with satisfactory outcomes eventually achieved. The Directors and Secretary were criticised by a particular group. It was not

until late in the conference that the allegations and legal threats were tactically withdrawn and a vote of full confidence in the leadership of Region 3 was passed. Without a strong Region, amateur radio will surely decline. NZART put in a lot of work to resolve these problems.

Seventeen Societies were present, and proxies represented seven. (NZART held the proxy for ORARI - Indonesia). This was a good representation, increased over the 2000 conference, although it became clear that some Delegates were not really representative of their societies. Some 76 papers were tabled, covering a wide range of subjects (including 15 from NZART). Two Working Groups were formed to deal with the bulk of the work, reporting back to the Plenary Sessions. They worked in parallel. Committees were also formed to deal with Credentials and Elections, Finance and Editorial matters. The Secretariat, headed by Keigo Komuro JA1KAB, functioned efficiently with major support from JARL and the local CTARL.

Ralph Yang BV2FB of CTARL did an excellent job as Conference Chairman in trying circumstances. The local CTARL team and helpers did an outstanding job of organising the mechanics of the Conference. They looked after the social events, airport travel and made everyone welcome. Their youth and enthusiasm was evident, and would be difficult to match.

Successful and well-attended workshops were held on the significant outcomes of WRC-03 – especially "Article 25"; and an IARU Co-ordinator Training/Liaison Workshop session. Social events also featured. They help to build long-term relationships. CTARL, JARL and the IARU/ARRL hosted receptions. On the Thursday a bus trip was organised to the National Palace Museum and other places of note in Taipei and the West Coast port city of Danshui. Outstanding issues continued to be actively discussed during this "recreation" time. A well-equipped special event station was also active from the conference hotel as BV0IARU.

An election was held for the five positions of Directors of Region 3 for the next three-year term. Fred Johnson ZL2AMJ retired. The other existing Directors offered to stand again and were all re-appointed (a vote of faith in them): YS Park HL1IFM (KARL Korea), Yoshiji Sekido JJ1OEY (JARL), Peter Naish VK2BPN (WIA) and Selva Selvadurai 9V1UV (SARTS Singapore). One new Director was elected – Chandru Ramchandra VU2RCR (ARSI) – from a field of four new candidates, after two stages of voting. The Directors elected Peter VK2BPN as their Chairman. Keigo Komuro JA1KAB was re-appointed as the Secretary. Various Region 3 Co-ordinators were appointed. They included Dr Rhee HL1AQQ (KARL) as EMC Co-ordinator, Yoshio Arisaka JA1HQG for ARDF, Masayoshi Ebisawa JA1DM as Convenor for STARS***, Peter Norden ZL2SJ as Beacon Co-ordinator (with Brett Graham VR2BG of HARTS to assist) and Keith Malcolm VK1ZKM filling a new position as the interim co-ordinator for Electromagnetic Radiation (EMR). Peter ZL2AZ continues to represent NZART on the STARS*** development task force.

Certificates of Appreciation were presented to Fred ZL2AMJ as the retiring Chairman and a Director (more than 15 years of service in total), and to Jamie Pye ZL2NN (retiring from his position as Region 3 Beacon Co-ordinator). Peter ZL2SJ accepted this on his behalf. David Sumner K1ZZ as the Secretary of the IARU made a presentation to David Wardlaw VK3ADW, retiring as Vice President of IARU after 5 years (and some 36 years of effort for Region 3).

Well-deserved votes of thanks, accompanied by plaques (including one from NZART) and other mementos, were given to CTARL for an outstanding job of organising the Conference.

Working Group 1: Policy Matters - WG1 was chaired by Terry ZL3QL, with John ZL4QS acting as Scribe. Peter ZL2SJ was also full time on this committee to present the relevant NZART papers and views. WG1 considered and recommended for adoption of a wide range of issues, including a

review of the Region 3 Strategic Plan. Two more objectives were added addressing membership and recruitment. The results of the ITU Conference WRC-03 were considered, with NZART congratulated on its progress in liberalising licensing and the early introduction of the new "Article 25". Hong Kong had also achieved major change and the cancellation of Morse requirements. Australia is well advanced and other societies are working on similar moves. Other issues included harmonisation of license qualifications, development of amateur radio and the diminishing numbers of amateurs.

Working Group 2: Technical and Operational Matters - Jim Linton VK3PC chaired WG2, with David Sumner K1ZZ acting as Scribe. Peter ZL2AZ represented NZART in the Working Group. Most of the documents with significant inputs and recommendations were those tabled by NZART, so he had a busy time introducing and explaining our activities. WG2 considered and recommended for adoption a very wide range of issues, including IARU AC recommendations, Region 3 band planning, amateur satellites, EMC, EMR, standards, the monitoring system, beacons, data transmission, ARDF, the Region 3 Award, emergency communications and a range of technical subjects.

A full report on the conference will appear in March/April Break-In.

Experience Marlborough 2004 NZART Conference:

When - Queens Birthday weekend, 5th & 6th June 2004.
Where - Marlborough Girls College, McLaughlan Street, Blenheim.

The 78th annual NZART conference in Marlborough the gourmet province is easily accessible by road, air and sea; there is no excuse not to come!

This year, Conference will commence with a brief opening ceremony followed immediately by the AGM. Forum topics, detailed in the last issue of HQIL are virtually finalised and include something for everyone. In Sunday's lineup expect SPAM, AREC, WARO, OTC and AMSAT-ZL.

The registration cost for the Marlborough 2004 Conference will be the same as for the Wairarapa Conference last year. Look for the Conference registration form in your next edition of Break-In. It will also be available on-line soon.

Accommodation remains at a premium in Blenheim for this holiday weekend so book early and avoid disappointment. For information see our website: www.zl2ks.com

Contact: Conference Secretary: Helen Harris ZL2TPT
Telephone or Fax: 03 575 7181
Or e-mail: mt.adde@xtra.co.nz

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FMTAG Notes for March:

APRS ON THE HF BANDS:

Following our request for comments on suitable frequencies for HF APRS, we have received messages from three APRS users. They emphasize several important points:

1. The frequencies used outside New Zealand are still evolving. It would be a mistake to prematurely fix the frequencies used in New Zealand.

2. Considerable confusion is caused by some users referring to their "dial frequency", instead of to the two radiated frequencies, when using an audio modem and SSB transmit mode. In SSB mode, the dial frequency is that of the suppressed carrier. There is little standardisation of the two audio tone frequencies, produced by different modem models or PC software, apart from them being separated by 200 Hz. This means that different dial frequencies are required to produce the same radiated frequencies.

3. APRS has been noted on two different frequency pairs on the 40 metre and 30 metre bands. The radiated frequencies are:

7.0342 MHz and 7.0344 MHz
7.0372 MHz and 7.0374 MHz
10.1492 MHz and 10.1494 MHz
10.1497 MHz and 10.1499 MHz

FMTAG has no recommendation, at this time.

FMTAG thanks Philip, ZL3GP, Noel, ZL3GR, and Rob, ZL3RX, for their valuable comments.

INTERIM RECOMMENDATIONS TO COUNCIL:
National system Band plan. **(As Attached to this issue of HQIL).**
APRS on the HF bands, as discussed above.

FINAL RECOMMENDATIONS TO COUNCIL:
None this month.
Attached Document: A FMTAG paper, **Eliminating SRD and ISM Interference To The National System** was distributed to NZART Council, in late February, for consideration at its March 2004 meeting. This paper is also attached to this issue of HQIL.

COMMENTS:
As always, we value your comments and suggestions on the above matters and recommendations, and on any other FMTAG matters.

Please send your comments by mail to FMTAG, NZART Headquarters, PO Box 40-525, Upper Hutt, or by e-mail to fmtag@nzart.org.nz

APPLICATIONS:
Applications for repeaters, beacons, digipeaters, point-to-point links, and so on, should be made on the latest version of FMTAG Form 10, which may be obtained from the above address, in paper or electronic versions. Completed forms should be sent to NZART Headquarters or by e-mail to fmtag@nzart.org.nz

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Contests with Stan White ZL2ST:

Upcoming contests are:
Saturday/Sunday March 27/28 0000-2400 UTC the second most popular annual worldwide event the CQ Worldwide WPX (Prefix) SSB Contest.
Saturday/Sunday April 3/4 0700-1000 UTC Thelma Souper Memorial Contest refer to WARO column in January/February Break In.

Results of the initial Boat Anchor Sprint held on February 21 in order are:

Jack Culloty	ZL1AJ	27 Points
Geoff Reed	ZL1AKY	21 Points
Philip Brown	ZL2IM	15 Points
John Nicholson	ZL1AUB	14 Points
Barrie Vivian	ZL2LA	12 Points
Tony Fletcher	ZL2ALJ	10 Points
Bernard Westerbaan	ZL1WT	10 Points
Roger Wincer	ZL2RX	4 Points

I would like to thank all of you who took part in the Boat Anchor Sprint. Conditions were a lot better than on Nostalgia night. The comments received have been all good so we will have another one later. Possibly a CW section could be added - what do you think? - **Mike ZL1MDS**

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BRANCH SPOT: - Branch 78 Celebrates 25 years - On the weekend of 26/27 June 2004, the Far North Districts Amateur Radio Club will celebrate 25years of operation. On Saturday 26th a formal dinner will be held at the Doubtless Bay Scouts hall at Taipa. This will cost $10.00 a head B.Y.O. and commence at 7pm.

On Sunday 27th June, a used equipment sale will be held at the same venue with doors open at 10.30a.m. The sale will be followed by a sausage sizzle. There will also be a sightseeing tour option available on the Sunday. An information pack will be sent out to those who register once final details are available. Registration can be made to Club Secretary rshack@xtra.co.nz or **to P.O. Box 4, Awanui , FAR NORTH 0552**.

Papakura Branch 65 - New Zealand VOIP Conference Server – With Nigel Goldstone ZL1UXD -

A New Zealand EchoLink conference server has been established by the Papakura Radio Club. It operates as "***ZL1VK* New Zealand Conference Server**" node number 65001.

So what does a conference server do? What can it be used for?
The EchoLink conference server is used to link, EchoLink computers, EchoLink simplex radio links and EchoLink repeater links together to hold nation wide or international nets or conferences. It can be used to run open nets that anyone can join or private nets that only approved call signs can use. An example of the type of nets that could be run using the conference server are NZART, AREC, WARO, Branch Nets, Amateur Interest groups, Branch Committee meetings etc or for New Zealand EchoLink users on a dial up connection, the conference server can be used to speak to a number of stations in a group which would not be possible without a fast Internet connection.

The conference server software has many advanced features such as being able to record and play files while other stations are having a net completely independent or as a group broadcast. It has the possibility to link to other VOIP systems such as IRLP, EQSO, Wires II or streaming audio over the net.

The NZART official broadcast will be transmitted through the conference server live. The weekly Auckland VHF Group net on Sundays at 8:15pm will also be transmitted through the conference server where hams both local and international will be able to listen in via EchoLink when connected to the *ZL1VK* EchoLink conference server. If you have missed the nets and want to catch up on what's happening both nets will be recorded so you can play them back at any time that is convenient.

All the information is available on the Papakura Club web site www.qsl.net/zl1vk with instructions for users. If you need help just ask. (Nigel ZL1UXD or David ZL1DK) call on the ZL1VK-R EchoLink node on the Ponga Repeater or email zl1vk@nzart.org.nz any groups or clubs that would like to use the server for nets or conferences or would like further information can contact Dave Karrasch zl1dk@nzart.org.nz

7:00 PM Sunday's New Zealand National VOIP Net - A New Zealand National VOIP Net is to be run on the ***ZL1VK*** conference server. This is open to all Branches, interest groups and amateurs throughout New Zealand. The aim of the net is to encourage communications between amateurs throughout New Zealand and assist and promote VOIP technology to expand the enjoyment of our amateur radio hobby via this mode. Branch representatives and individual amateurs are invited to participate or just listen-in.

The Agenda for the NZ National VOIP Net is:

- News about IRLP nodes - (All IRLP node controllers or potential controllers are invited to contribute here)

- News about EchoLink - R / -L nodes (All EchoLink node controllers or potential controllers are invited to contribute here)
- News about other VOIP systems (Wires II, EQSO, etc.)
- NZ EchoLink Conference Server announcements
- Other VOIP nets, requests
- General Check In
- Net Closed…. Followed by open question, chat forum

The net controllers will be Nigel Goldstone ZL1UXD & David Karrasch ZL1DK zl1dk@nzart.org.nz

All welcome, we look forward to hearing you on ***ZL1VK*** New Zealand Conference server at 7:00 PM every Sunday. Please remember to connect to the ***ZL1VK*** conference server not the ZL1VK-R EchoLink node. Many of the EchoLink Repeaters and radio links will be connected for this net so radio users are most welcome.

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Amateur Licence Statistics from the Ministry of Economic Development's web site with Tony Case ZL1UD:

Statistics				
Amateur Radio Licensing Statistics				
	Category	**Date**	**Date**	**Date**
		Jan.23,04	**Feb.26.04**	**Mar.23.04**
	General Grade	3168	3171	3173
	Limited Grade	1534	1541	1543
	Novice Grade	12	12	12
	Total Licensed Amateurs	**4714**	**4724**	**4728**
	Beacons	42	42	42
	Digi-peaters	29	29	29
	Fixed	2	2	2
	Repeaters	211	211	219
	TV Repeaters	19	19	19
	Total Licenses	**5017**	**5027**	**5039**

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Dates To Remember:

- **Next NZART Official Broadcast 8pm & 9pm on Sunday 28th March**
- **Next HQ-Info-Line e-mailed on Sunday 4th April**

- **NZART Conference 5th and 6th June 2004 at Marlborough Girls College, Blenheim.**

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73

Jim Meachen ZL2BHF

Editor

The following FMTAG paper was distributed to NZART Council, in late February, for consideration at its March 2004 meeting.

ELIMINATING SRD AND ISM INTERFERENCE TO THE NATIONAL SYSTEM

RECOMMENDATION

That the operating frequencies of the National System be changed to the eight new channels (434.800 MHz to 434.975 MHz and 439.800 MHz to 439.975 MHz) in accordance with the FMTAG frequency plan (Appendix 3).

This appears to be the only viable long-term solution that gives acceptable performance and is compatible with the present National System structure. The other proposed options have performance or operational problems.

However, this proposal has the highest labour cost.

INTRODUCTION

FMTAG has been asked to provide advice on how best to eliminate SRD and ISM interference to the National System.

Several proposals have been discussed. The main proposals are:

1. Invert the input-output frequency split of all the National System equipment.

2. Add CTCSS to all the receivers in the 433.05 MHz to 434.79 MHz band.

3. Move to 434.800 MHz to 434.975 MHz and 439.800 MHz to 439.975 MHz.

However, some of the observed National System interference is not caused by SRD or ISM equipment, but by under-engineered National System equipment and by un-authorised extensions. Moving to the new frequencies will not cure any of these problems.

To be viable in the long-term, any method of eliminating SRD or ISM interference on the National System must be capable of universal application.

WHAT IS A SHORT RANGE DEVICE (SRD)?

The MED has permitted SRDs for many years. However, each re-issue of the General User Radio Licence (GURL) has successively permitted additional modulation modes and increases in radiated power.

In reality, the term SRD is sugar coating for what is, potentially, a long range device (LRD).

The theoretical free-space propagation distance of an SRD is over 200 km, assuming that the SRD radiates the maximum permitted power, under the May 2003 GURL, and the 70cm repeater has a good performance receiver. So much for it being a "short range device".

Put another way, since most major cities/towns are within 10 km of the local National System repeater, the signal from a legal SRD could be up to 26 dB above the trigger threshold of the repeater, assuming free-space propagation.

Alternatively, 26 dB of obstruction loss, between the SRD and repeater, could still cause triggering of the repeater.

Some (illegal) SRDs have even higher transmitter powers.

INVERT THE INPUT-OUTPUT FREQUENCY SPLIT

At the moment, most of the interference occurs to the repeaters and ULS (receiving on channels 3abc and 4def and transmitting on channels 8abc and 9def) located near the main centres.

This proposal requires that every station in the National System interchanges transmit and receive frequencies. This solves the problem in the main centres, but transfers the problem to the provincial centre repeaters, presently receiving on channels 8abc and 9def and transmitting on channels 3abc and 4def.

However, all of the provincial repeaters are close to substantial size cities (Whangarei, New Plymouth, Napier, Hastings, Nelson, Masterton, Timaru), so will be susceptible to a slightly lower incidence (due to lower total population) of the same type of interference.

This is not a viable long-term solution.

CTCSS ON THE NATIONAL SYSTEM

CTCSS, by itself, is unsuitable for universal application on the National System, because of the accumulation of time-to-detect and time-to-release.

To fully protect the National System, in the long term, it would be necessary to install a CTCSS decoder in every 433.05 MHz to 434.79 MHz receiver. Unfortunately, the growth in the numbers of SRD and ISM equipments will eventually mean that every 433.05 MHz to 434.79 MHz receiver in New Zealand will be affected.

Therefore, if this proposal is to be viable in the long-term, the performance implications of installing a CTCSS decoder on every 433.05 MHz to 434.79 MHz receiver must be considered.

The present National System includes a 433.05 MHz to 434.79 MHz receiver at every non-inverted repeater (the usual access point for over half of the users) and at every ULS (at each end of linking segments either side of an inverted repeater).

Thus, for example, the signal of a user at, say, Doubtless Bay would pass through the following equipment, on its way to Queenstown:

Receiver name	Frequency	CTCSS decoder needed?
Doubtless Bay	439.050 MHz	No
Bay of Islands ULS	434.050 MHz	Yes
Brynderwyn	439.075 MHz	No
Auckland ULS	434.075 MHz	Yes
Egmont	439.025 MHz	No
Belmont ULS	434.025 MHz	Yes
Blue Duck	438.975 MHz	No
Christchurch ULS	433.975 MHz	Yes
Waitaki	439.025 MHz	No
Dunedin ULS	434.025 MHz	Yes
Balclutha	439.075 MHz	No
Invercargill ULS	434.075 MHz	Yes
Obelisk	439.abc MHz	No
Queenstown ULS	434.abc MHz	Yes

In other words, the signal would have to pass through, and trigger, seven CTCSS decoders before the Queenstown repeater transmitter turned on.

The manufacturers of CTCSS decoders are vague about the performance of their decoders, particularly the specification for time-to-detect and time-to-release. They usually state: 250 ms (typical), without specifying the tone frequency. However, we will assume that this is the performance for the middle tone frequency: 127.3 Hz.

In most CTCSS decoders, the fractional bandwidth of the tone filter is constant. The lower frequency tone filters have narrower bandwidths, since the lower tone frequencies are closer together, implying a proportionally longer time-to-detect.

For practical and operational reasons, only one CTCSS tone would be used throughout the National System for interference avoidance purposes. It would originate in the user's transmitter, and propagate unimpeded throughout the National System.

Which tone frequency?

88.5 Hz is the default CTCSS setting in many Japanese rigs, and could be simply generated in an add-on to existing, non-CTCSS-equipped, rigs.

It is reasonable to assume that the time-to-detect at 88.5 Hz, the most popular repeater access tone frequency, is (127.3/88.5) times longer than the time to detect at 127.3 Hz, or:

(127.3/88.5) x 250 ms = 360 ms

Therefore, a signal passing through seven CTCSS decoders requires 7 times 360 ms = 2.5 seconds before the last transmitter is triggered. The time-to-release is similar.

The long delays are likely to seriously impede, or prevent, the overnight Packet forwarding, since the total turn-round delay is double the one-way delay, a total of 5 seconds, in the above example.

MOVE TO NEW 70 cm FREQUENCIES

Are there enough frequencies?

The existing frequency plan uses fifteen frequencies; the new plan proposes seven frequencies (plus Saddle Hill).

A previous FMTAG paper discussed the difficulties of fitting all of the existing, and proposed, stations into the seven-frequency plan. The plan requires frequency sharing in the Waikato, and between Belmont and Wanganui, and deletion of one repeater on the Kapiti Coast and one in Hawkes Bay.

Frequency sharing, at closer separation distances than desirable, will cause some co-channel interference. The interference can be minimised by more accurate control of the relevant repeater carrier frequencies, presently one part per million; one part in five million would be desirable.

The main effect is a beat note, behind the audio. The frequency of the note corresponds to the difference between the repeater carrier frequencies; the amplitude of the note depends on the ratio of the carrier amplitudes. Users can minimise these effects by using directional antennas.

These effects, and many others, are discussed in the book: Principles of Frequency Modulation, by B.S. Camies, published by Illife in 1959.

Would more frequencies be available if we halved the channel spacing?

Halving the channel spacing, to 12.5 kHz, while retaining 5 kHz peak deviation and full bandwidth receiver IF filters, does not produce twice as many available frequencies, because of spectrum overlap. Camies also discusses this.

Interference-free operation, with 12.5 kHz channel spacing, requires the transmitter deviation to be halved to 2.5 kHz and the receiver IF bandwidth reduced to 11 kHz. When compared with normal equipment (25 kHz channel spacing and 5 kHz deviation), the signal-to-noise ratio is 3 dB worse, for a given receiver input signal level. Similarly, the harmonic distortion (mostly odd-order distortion) of the demodulated audio approximately doubles, depending on the phase distortion characteristic of the respective receiver IF filters.

Every transmitter and receiver (repeaters and user's transceivers) would need to be modified, to avoid the effects of spectrum overlap.

IMPLEMENTATION

The recommended frequency-change proposal has the highest labour cost, requiring the retuning of all repeater transmitters, receivers, duplexers and filters. However, it does not require a "big bang" changeover. Individual linking segments, consisting of an inverted repeater in the middle, and a ULS at each end, can be changed at any time suitable to the Trustees. Individual linking segments will be out of operation for only a few hours. Additional, temporary filters will be needed if there is insufficient isolation between the multiplicity of repeater and ULS antennas at the major "hubs".

The frequency inversion proposal has a slightly lower labour cost, requiring the retuning of all repeater transmitters, and receivers. Some duplexers and filters may need retuning, if they are of the asymmetric performance type. However, this proposal requires a simultaneous "big bang" changeover of all stations, if massive de-sense and inter-station lock-up is to be avoided. The National System is likely to be out of operation for weeks, or months, while the meagre supplies of suitably experienced technical talent moves around the country.

The CTCSS proposal has the lowest cost, but the worst performance.

UNAUTHORISED EXTENSIONS

Trustees always welcome reports of "double squelch tails" on transmissions, together with the callsign of the station having the "double tails". Double tails usually indicate that the station is making use of an un-authorised add-on to the National System.

The double tails, poor audio quality and random triggering, are characteristic of the "nobody is going to tell me what I can and cannot do" attitudes of the people responsible for these badly engineered stations.

APPENDIX 1 EXTRACTS FROM THE NATIONAL SYSTEM SPECIFICATION

5.2 CONTINUOUS TONE CONTROLLED SQUELCH SYSTEM (CTCSS)

Frequencies: Only EIA Standard tones shall be used

Tolerance: Encoder: nominal frequency +/-0.1%. Decoder: +/-1%.

Carrier deviation: 0.5 kHz

Amplitude Range: The decoder shall operate with tones +2 dB and -10 dB from the nominal deviation.

Response time: For frequencies less than 100 Hz, 350 ms maximum. For frequencies above 100 Hz, 250 ms maximum.

Talk-off: >20 dB 300 Hz - 3.4 kHz.

NOTE

1. CTCSS may be required for some system applications. However the digital CODECS used in the main system are designed to notch (more than 10 dB attenuation) tone frequencies up to 100 Hz. Therefore, system end CTCSS control shall use tones between 67.0 Hz and 85.4 Hz.

2. Users wishing to use CTCSS for selective calling shall use tones between 123.0 and 250.3 Hz.

It is likely that the turnaround delay specification precludes the use of CTCSS or DTMF signalling for National System control. Suitable systems are under study.

APPENDIX 2 EXTRACT FROM NZART REPEATER CODE OF PRACTICE

SUB-AUDIBLE SELECTIVE TONE CODING
(CONTINUOUS TONE CONTROLLED SQUELCH SYSTEM - CTCSS)

This technique was developed as a method of selective calling, so that listeners, on busy channels, weren't disturbed by messages not intended for them.

Unfortunately, selective calling has many bad side effects, which reduce the performance of any system in which it is used. The CTCSS tone is transmitted continuously, and is chosen from 38 frequencies between 67.0 Hz and 250.3 Hz.

High-pass filters are used in both the transmitter and receiver audio stage. The filter in the transmitter is necessary to prevent low frequency audio contaminating any CTCSS tone. The filter in the receiver is necessary to prevent the users being disturbed by the CTCSS tone. Both filters affect the overall audio frequency response up to, and beyond 1 kHz.

The use of a low frequency tone necessarily increases the time to detect, and the time to release. The tone takes up some of the available deviation and, therefore, the audio deviation has to be correspondingly reduced. Audio non-linearity anywhere in the system, plus multipath between transmit antenna and receive antenna, cause the traffic audio to be modulated by the tone. The tone inserted at each station propagates throughout a linked system of repeaters, and the multiple high-pass filters, required to remove them, also degrade the low frequency end of the audio frequency response.

The deviation of the individual tones is additive. So, in a linked system of repeaters, such as the National System, the accumulation of transmitter deviation, caused by CTCSS tones, leaves little deviation for the real traffic!

For example, if CTCSS tones are adjusted to the recommended 500 Hz deviation, at each transmitter, only half of the available deviation remains available for traffic after five repeaters, or no deviation after ten repeaters.

CTCSS selective calling has been proposed as a magic cure-all, to eliminate unwanted repeater triggering, due to interference and intermodulation. CTCSS selective calling can eliminate some types of unwanted triggering. But, if the intermodulation generation mechanism involves the CTCSS-equipped transmitter, the CTCSS tone shows up as a component of the intermodulation, will be accepted by the receiver's CTCSS tone decoder, and the interference will persist.

Unfortunately, selective calling only eliminates some of the unwanted triggering, merely delaying the time when the real cause of the interference and intermodulation has to be found, and cured.

Intermodulation is usually created at the repeater site, by a wide range of different mechanisms. Some mechanisms are due to poor equipment design (receivers and/or transmitters), or the use of inappropriate equipment (the wrong type of duplexer); other mechanisms are due to the degradation/ageing of previously properly working equipment, such as antenna systems (antennas and support/tower hardware).

The most frequent cause of intermodulation is overload of the receiver by one, or more, transmitters on the site. As previously mentioned, a high degree of transmitter/receiver isolation is required.

Aluminium-based antennas are the second most frequent cause of intermodulation.

APPENDIX 3

NATIONAL SYSTEM NEW FREQUENCY PLAN - TRANSMIT FREQUENCIES

434.800 MHz Avoid using this frequency. Saddle Hill
439.800 MHz Belmont ULS facing Saddle Hill, Nelson ULS facing Saddle Hill

434.A MHz Brynderwyn, Wairarapa, Murchison
439.A MHz Bay of Islands ULS facing Brynderwyn, Whangarei ULS facing Brynderwyn, Auckland ULS facing Brynderwyn, Belmont ULS facing Wairarapa, Nelson ULS facing Murchison

434.B MHz Doubtless Bay, Egmont, Waitaki
439.B MHz Bay of Islands ULS facing Doubtless Bay, Auckland ULS facing Egmont, Taupo ULS facing Egmont, Wharite ULS facing Egmont, Wanganui ULS facing Egmont, Kapiti ULS facing Egmont, Belmont ULS facing Egmont, Christchurch ULS facing Waitaki, Dunedin ULS facing Waitaki

434.C MHz Kaimai, Mount Erin, Blue Duck, Balclutha
439.C MHz Auckland ULS facing Kaimai, Hamilton ULS facing Kaimai, Waitomo ULS facing Kaimai, Rotorua ULS facing Kaimai, Edgecumbe ULS facing Kaimai, Wharite ULS facing Mount Erin, Gisborne ULS facing Mount Erin, Belmont ULS facing Blue Duck, Christchurch ULS facing Blue Duck, Dunedin ULS facing Balclutha

434.D MHz NIL
439.D MHz Taupo

434.E MHz NIL
439.E MHz Bay of Islands, Hamilton, Edgecumbe, Wharite

434.F MHz NIL
439.F MHz Auckland, Gisborne, Wanganui, Belmont, Greymouth, Christchurch Invercargill

434.G MHz NIL
439.G MHz Whangarei, Rotorua, Waitomo, Kapiti, Nelson, Dunedin

APPENDIX 4

PATH PROFILES – LINKING PATHS (CHECKING FOR PATH OBSTRUCTIONS)

NOTES ON PATH RATING

LINKING PATHS

A positive number indicates a line-of-sight radio path, assuming 4/3rds Earth radius propagation conditions. A positive number greater than one usually indicates an excellent linking path. Linking paths with a negative number will be subject to time-varying performance and co-channel interference from distant linking stations.

FREQUENCY PROFILE NUMBER	FROM TO	DISTANCE km	PATH RATING	BEARING degrees
439.800 MHz				
16	Belmont ULS to Saddle Hill	121	+1.5	264
27	Nelson ULS to Saddle Hill	10	+7	69
439.A MHz				
28	Brynderwyn to Bay of Islands ULS	110	-2.6	330
3	Brynderwyn to Whangarei ULS	40	+0.1	350
11	Brynderwyn to Auckland ULS	147	-1.5	166
10	Wairarapa to Belmont ULS	72	-4	263
19	Murchison to Nelson ULS	83	+1.8	56
439.B MHz				
26	Doubtless Bay to Bay of Island ULS	54	0	135
37	Egmont to Auckland ULS	223	+0.6	17
42	Egmont to Taupo ULS	148	+3	80
41	Egmont to Wharite ULS	185	+1.5	126
38	Egmont to Wanganui ULS	110	+0.4	132
46	Egmont to Kapiti ULS	193	+2.5	154
36	Egmont to Belmont ULS	219	+0.7	163
32	Waitaki to Christchurch ULS	179	+2	50
45	Waitaki to Dunedin ULS	131	+0.1	193

439.C MHz

43	Kaimai to Auckland ULS	115	+1.5	300
44	Kaimai to Hamilton ULS	56	-0.7	275
2	Kaimai to Waitomo ULS	71	+2	220
39	Kaimai to Rotorua ULS	47	+1.5	120
40	Kaimai to Edgecumbe ULS	75	+0.7	110
4	Mount Erin to Wharite ULS	101	+1	235
8	Mount Erin to Gisborne ULS	120	+3	33
30	Blue Duck to Belmont ULS	144	+0.5	39
12	Blue Duck to Christchurch ULS	182	-0.7	211
5	Balclutha to Dunedin ULS	103	+1.5	63

APPENDIX 5

PATH PROFILES COVERAGE AREA TO COVERAGE AREA (CO-CHANNEL INTERFERENCE)

NOTES ON PATH RATING

CO-CHANNEL INTERFERENCE PATHS

A negative number indicates an obstructed path. A large negative number indicates that co-channel interference in the coverage area (from another repeater on the same channel) will be minimal. A small negative number indicates that there will be time-varying and location-varying co-channel interference.

FREQUENCY PROFILE NUMBER	FROM TO	DISTANCE km	PATH RATING	BEARING degrees
434.A MHz				
109	Brynderwyn to Wairarapa	570	-15	169
110	Brynderwyn to Murchison	650	-15	194
112	Wairarapa to Murchison	278	-7	255
434.B MHz				
67	Doubtless Bay to Egmont	494	-9	173
69	Doubtless Bay to Waitaki	1106	-36	190
75	Egmont to Reefton	365	-10	210
76	Egmont to Waitaki	651	-20	203
434.C MHz				
56	Kaimai to Mount Erin	220	-7	159
90	Kaimai to Blue Duck	513	-12	200
92	Kaimai to Balclutha	1074	-35	208
87	Mount Erin to Blue Duck	374	-7	222
89	Mount Erin to Balclutha	943	-28	218

94	Blue Duck to Balclutha	570	-14	217

439.E MHz

115	Bay of Islands to Hamilton	320	-6	156
116	Bay of Islands to Edgecumbe	414	-8	142
117	Bay of Islands to Wharite	588	-15	163
118	Bay of Islands to Westport	751	-20	193
47	Hamilton to Edgecumbe	129	-3	104
120	Hamilton to Wharite	273	-9	170
48	Edgecumbe to Wharite	250	-7	197

439.F MHz

55	Auckland to Gisborne	294	-7	125
52	Auckland to Wanganui	289	-6	176
79	Auckland to Belmont	424	-10	179
81	Auckland to Christchurch	718	-24	194
53	Gisborne to Wanganui	253	-7	240
83	Gisborne to Belmont	349	-8	221
85	Gisborne to Christchurch	674	-17	217
1	Wanganui to Belmont	136	-3	186
59	Wanganui to Christchurch	452	-15	205
62	Belmont to Christchurch	326	-5	214

439.G MHz

96	Whangarei to Rotorua	451	-11	141
97	Whangarei to Waitomo	309	-3.5	162
98	Whangarei to Kapiti	574	-14	174
99	Whangarei to Nelson	627	-16	188
100	Whangarei to Dunedin	1165	-36	195
29	Rotorua to Waitomo	91	-0.6	250
101	Rotorua to Kapiti	325	-11	325
102	Rotorua to Nelson	443	-9	216
103	Rotorua to Dunedin	984	-35	208
104	Waitomo to Kapiti	277	-5	185
105	Waitomo to Nelson	372	-6	208
106	Waitomo to Dunedin	919	-35	204
49	Kapiti to Nelson	158	-5	251
107	Kapiti to Dunedin	663	-15	212
108	Nelson to Dunedin	547	-14	203

END