TAPR #100 SUMMER-AUTUMN 2006

PACKET STATUS REGISTER

President's Corner

2006 Wrap-Up/2007 Warm-Up

Well, the Dayton Hamvention and the DCC have come and gone, and we are heading into the winter doldrums for those of us in the northern hemisphere … our BoD member Darryl Smith will remind us that things are starting to liven up down under, though, with spring coming to Oz!

So, I am really here to tell you that things are in fact ramping up here in TAPRvania …

Dayton saw some exciting moments for us … we met old friends and made new ones.

We had a successful "Packet Bash", but it also marked the **last** TAPR Bash. But the better news is that we have merged our gathering with that of AMSAT and we'll be hosting a joint gathering at Dayton 2007 – at the Air Force Museum on Friday night. Current plans call for a dinner in the vicinity of $30-35 and we'll have the run of the place before and after the dinner. I know that many of us are members of both organizations and will welcome the chance to get everyone together. Both groups will be changing the format of their dinners into a new format more suited to the new venture. We will, however, need to do this affair as a pre-paid event **BEFORE** we get to Dayton, as the logistics will be a little tighter for this soiree, so watch the PSR and other announcements for details.

In September, we returned to Tucson for the DCC. We had many noteworthy founders of the organization present, and they were all invited to say a little something after dinner. As I looked around the room, I could catch glimpses of tears of sadness for those who were no longer with us, as well as tears of laughter as folks poked fun at themselves and related many a tale of the trials and tribulations of projects gone by. The take home message from TAPR's early days is that the developers of the TNC1 made a conscious decision to not make a personal or professional dime out of the organization, and it was that single water-shed decision that has provided us with 25 years of viability and relevance to the amateur community. While we marveled at their perseverance and sacrifice, we took aim at a new generation of projects, and announced our involvement with the HPSDR project.

HPSDR stands for **H**igh **P**erformance **S**oftware **D**efined **R**adio. It started out as a small group of individuals tinkering with ways to improve their SDR-1000 software defined HF radios. They designed a backplane (dubbed Atlas) and then two boards to act as high-performance replacements for the sound card in their PCs. (The sound card is the computer to radio interface for the software defined radio). These cards were dubbed Janus for the card handling A-D and D-A for the "sound" side of things, and Ozymandias (affectionately known as Ozy) to handle the radio keying/switching.

The group and TAPR had initial discussions at Dayton, and we were excited to get involved. TAPR offered to act as facilitators for the project, or as I like to say, we offered to act as the glue to bring people and things together. The projects all remain under the control of the board designer/builder, and TAPR acts as a general contractor. We handle the logistics of final board layout with the developer, although at this point, they had already done most of that and had working boards. We are moving to Alpha2 or Beta testing at this time, and will soon be ready to go into production. Steve Bible is acting as primary liaison for TAPR, with Scott Cowling, a new BoD member providing us with his production expertise. Eric Ellison has been a big promoter of the HPSDR project from its inception, and he too has joined the BoD. Congratulations to both Scott and Eric on their election, and to John Koster on his re-election.

The HPSDR list has about 400 members and is growing. When the developers are satisfied that the Beta run is satisfactory, then we'll proceed to production. Atlas is available now through TAPR as a kit … it will require some magnification and some soldering skill, but is doable as a kit. Janus and Ozy will be fully assembled AND tested boards with price to be announced. These boards are not something that can be easily built by everyone, so will not be offered as kits, but we may make a limited number of bare-boards available. We will not be providing parts if someone wants to "roll their own". We will be asking buyers to pre-purchase the boards with a short lead-time. That is, they will be asked to pay in full to fund this project and we'll deliver tested boards within something like 4-5 weeks. This is the only way to get quantity discounts to hold costs down. With an established base of folks from the HPSDR list, we believe that we will have a large, ready-made base of purchasers. The costs of subsequent runs may not be as low in cost because of numbers – things are cheaper in quantity – so if folks are interested, they need to monitor the TAPR web site to try to get in on the first wave.

Now, you may be asking yourself why anyone would go to the trouble of buying these boards just to talk to their SDR-1000, when a sound card or a USB or Firewire solution is available already?

The HPSDR design is modular. Atlas allows us to add other boards to the system as they develop. There are already plans for receivers and transceivers, and a board to remove the dependence on an external computer. Please go to **www.hpsdr.org** for full descriptions of the proposed projects. Right now, we are committed to Atlas, Janus, Ozy, and Pinocchio (an extender card to allow you to debug and trouble shoot boards –this will be available as a kit like Atlas). As other developers make proposals, we will go through the process of vetting each project. The profits made on the card sales will go towards funding future projects in HPSDR and other projects. Discounts will be offered to TAPR members. AMSAT has donated development tools to project members, as well as financial support in the form of interest free loans to speed up development. In return, they hope to see the development of widgets that will greatly improve ground-station performance. AMSAT has already a Software Defined Transponder for Eagle, its future Phase 3 satellite.

Just as the TNC ushered in an unprecedented growth in digital communications, software defined radios will forever change the way we communicate, and our organization will stand ready to foster this new technology. We want to "free-up" the developers to develop, and accept the day-to-day concerns of production. We're still trying to improve our skill-set here, but the developers are being patient with us!

John Ackermann has been working on the TAPR-OHL (the Open Hardware License), based loosely on the Open Source License, as a means to secure intellectual property in projects such as HPSDR. This will allow folks to exercise control over their intellectual property. They could give it away for anyone to use, or they could license it for non-commercial applications, and retain control of it for commercial applications of their own choosing. This is an overly simplistic explanation of a very important topic, but the development of the OHL will be needed to enable us to do other collaborations such as HPSDR. This too is a landmark development and John and TAPR are definitely breaking new ground, and the world is definitely watching this. Everyone at the DCC was impressed by the effort that John has put into this, and the way that he has been able to develop a consensus of opinion among several of his legal colleagues who have provided comments on this and the developers with whom we are now working.

John will be providing us with updates.

I always cringe when I have to try to find something to share with you. I am amazed by the fact that I've had so much to share, and have to cut myself off and bid you all well.

As always, we want to hear from you. Let us know if you think we are sailing in the right direction, or if you have suggestions for projects. I think as techies ourselves, I/We still need to improve our basic communication skills with YOU.

73,

Dave VE3GYQ/W8

Spencerville, Ohio

###

Digital Voice in Hello ARRL Special Event

By Mel Whitten, K0PFX

Digital Voice operators around the world are invited to participate in this special event "Hello"… This event is celebrating the centennial of voice transmissions over the airwaves on Saturday December 29 and Sunday December 30, 2006. Both AOR 9000 / 9800 Digital Voice modems and WinDRM software may be used. During the event, use the AOR and WinDRM "On-Line-Finders" found at **www.n1su.com** and enter your Call/QRG/QTH/ and information on your activity under Comments.

Look for further information on this event at **www.hamradio-dv.org** and the ARD9800 and WinDRM reflectors. Calling frequency will be 14.236. Other DV frequencies are listed on the hamradio-dv.org and n1su.com web pages. Submit your logs to KQ6EH at hamradio-dv for a chance to win a new AOR ARD-9800 Fast Radio Modem.

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Doug McKinney, KC3RL, Silent Key

Former TAPR Director Doug McKinney, KC3RL, became a silent key on December 14, 2006. Doug was a graduate of the Naval Post Graduate School and a retired U.S. Navy Submarine Commander. He later pursued a career as a design engineer and developed his own company.

During his years with TAPR, Doug developed a variety of projects for the organization including interface boards for the Oncore VP/UT+/GT+ GPS, Garmin GPS-20/GPS-25, and the DGPS module. He also authored the TAPR project developer's guide.

An Advanced class Amateur Radio licensee, Doug resided in Chandler, AZ and was 61 years old at the time of his death.

###

Dayton News

TAPR has entered into an agreement with AMSAT to hold a joint banquet at the Air Force Museum on Friday evening of the Dayton Hamvention weekend. In the past, TAPR and AMSAT ate in separate banquet facilities on Friday evening, which forced members who belonged to both organizations to choose between banquets. Not anymore!

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DCC News

TAPR's Board of Directors selected Hartford, CT as the site for the 2007 TAPR/ARRL Digital Communications Conference (DCC) and Chicago, IL for the 2008 DCC.

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TAPR Celebrates 25th Anniversary at DCC

From *The ARRL Letter*

Some 100 communication enthusiasts gathered in Tucson, Arizona, September 15-17 for the TAPR/ARRL Digital Communications Conference (DCC). This conference marked the 25th anniversary of the formation of TAPR (Tucson Amateur Packet Radio).

TAPR was one of the driving forces behind the packet radio revolution that began in the middle 1980s, and it continues to be at the cutting edge of Amateur Radio innovation. In recent years, the organization has moved away from its full name, Tucson Amateur Packet Radio Corporation, and begun to identify itself solely as "TAPR." As its president David Toth, VE3GYQ, explained earlier this year, "We're not just about packet radio anymore, and we haven't been just about packet radio for some time." TAPR has broadened its scope into the entire arena of packet and digital communications. It also offers kits for experimenters.

DCC 2006 topics included progress reports on the status of the Eagle Project **<www.amsat.org/amsat-new/eagle/index.php>**, the next high-altitude satellite planned by AMSAT-NA, as well as developments in software-defined transceivers and APRS **<www.arrl.org/tis/info/HTML/aprs/>**. During the event, Kenwood displayed a new 2-meter/70-cm transceiver, which will come on the market early next year and does not yet have a model number.

TAPR has announced that Eric Ellison, AA4SW, and Scott Cowling, WA2DFI, have been elected as new members of the TAPR Board of Directors. John Koster, W9DDD, was re-elected to a new term on the Board.

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TAPR pioneers at the 25th Anniversary cake. From left to right: James Fortney, K6IYK; Pete Eaton, WB9FLW; Bill Reed, WD0ETZ; Mel Whitten, K0PFX; Mike Parker, KT7D; Chuck Green, N0ADI; Lyle Johnson, KK7P; Mike Baker (no call); Dan Morrison, KV7B; Fried Heyn, WA6WZO; Bob McGwier, N4HY; Eric Gustafson, N7CL (Photo by Mark Raptis, KF6WTN)

New TAPR Board Members

The recent TAPR election resulted in the election of two new board members (AA4SW and WA2DFI) and the re-election of one board member (W9DDD). Here are their brief biographies.

Scott Cowling, WA2DFI

Scott was first licensed in 1967 at age 14. He has been continuously active and on the air since then. He enjoys mobile CW, FD (just completed his 38th consecutive one), APRS, kit building, Software Defined Radios, and public service. He is an advisor for Explorer Post 599, the ham club for teens in the Phoenix area. He has been the president of a small, but successful electronics-consulting firm for the past 11 years. With the combination of his ham radio and business experience, he feels he can contribute to the growth, management and continued well-being of TAPR.

Scott's contact information:

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Tempe, AZ 85285-6843
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Eric Ellison, AA4SW

Eric was first licensed as a Novice in 1965, reaching Extra in 1969. He was very involved in the early years of packet, in both GRAPES and TAPR.

He is a life member of ARRL, and a member of RSGB and TAPR. A true digital aficionado, Eric enjoys rag chewing on CW, especially 20 meters.

Eric was an early adopter of the SDR-1000 Software Defined Radio, and has been an enthusiastic advocate for SDR users worldwide. He has been the moderator for the SDR forum at Dayton for the past two years.

For two years he has also hosted the Internet based, Teamspeak VoIP group conferencing for the advancement of SDR and many other ham radio related topics. Teamspeak has provided private conferences for AmQRP, AMSAT and TAPR.

He worked for 27 years as an agricultural research scientist, and for the last 18 years as an IT professional.

Eric is been married to Kathy, N4RVU, has three children and five grandchildren.

Eric's contact information:

Eric Ellison, AA4SW
5276 E Shore Dr
Conyers GA 30094
e-mail: **ecellison@comcast.net**

John Koster, W9DDD

John has been involved with amateur digital communications since 1959, acquiring his first Teletype shortly after becoming licensed.

John contributed to the development and deployment of TexNet while a member of TPRS (Texas Packet Radio Society).

John enjoys the R&D/building side of the amateur radio hobby. He has been involved in the production and/or design of several TAPR kits. The Compact Flash Adapter, PIC-E, T-238, to name only a few.

He began his involvement with TAPR in 1994 serving as board member. He presently shares Office Manager duties with his wife Laura.

John resides in Richardson, TX and is retired.

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Catalog on Line

The complete TAPR catalog is on line at **https://www.tapr.org/products.php** there you will be able to join TAPR, renew your membership, buy parts, buy kits, buy goodies, buy books, and buy software that TAPR produces and/or distributes.

Recent additions to the TAPR catalog include:

TADD-ENC, Enclosure for the TADD series of kits **<www.tapr.org/kits_tadd-enc.html>**

ANT1A, A version of the AN97, which is designed for bracket mounting rather than magnetic, mount **<www.tapr.org/gps_ant1a.html>**

Atlas PCB, The backplane for the HPSDR project **<www.tapr.org/kits_atlas.html>**

Atlas parts kit, parts to populate the Atlas backplane **<www.tapr.org/kits_atlas.html>**

Pinocchio, the extender board for the HPSDR project **<www.tapr.org/kits_pinocchio.html>**

The Clock Block, a flexible frequency synthesizer for timing applications **<www.tapr.org/kits_clock-block.html>**

###

Clock-Block

By John Ackermann N8UR, jra@febo.com

Some time ago I mentioned that I was working on a clock synthesizer board that could be used (among other things) to get much better timekeeping for applications like NTP.

The idea is to replace the motherboard crystal with a connection to the synthesizer, which can be programmed to generate the correct frequency when driven by a higher quality external oscillator. The end result is a PC clock that's far more accurate and stable than the original crystal can provide.

I'm pleased to announce that my project worked out, and TAPR is now taking orders for the "Clock-Block" as a fully assembled unit (however, you'll still have to do some soldering on your motherboard to replace the crystal with the connection to the Clock-Block).

We are having the first batch manufactured now, and hope to begin shipment within a couple of weeks. I'm pleased that we'll be able to offer the assembled unit for a price not much more than I originally thought a kit version would cost; the circuit uses surface mount parts that might be challenging for some folks to solder, so offering it assembled makes life easier for everyone.

There's more information about the Clock-Block, and you can place an order, at **www.tapr.org/kits_clock-block.html**.

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TADD Enclosure

By John Ackermann, N8UR, jra@febo.com

TAPR is pleased to announce that the TADD Enclosure is now available.

It's an attractive metal case designed to hold any of the TADD series boards. You can get more information, and place an order, at **http://www.tapr.org/kits_tadd-enc.html** (click on the small pictures on the web page to see larger versions).

The TADD Enclosure costs $35 for TAPR members, and $39 for non-members.

###

D-PRS

By Pete Loveall, AE5PL, pete@ae5pl.net

D-PRS is the acronym coined by Icom America for the D-STAR/APRS gateway designed by Peter Loveall AE5PL as an adjunct to javAPRSSrvr and as a stand-alone application. This white paper describes the Icom GPS implementation using the D-STAR low speed data channel, the APRS requirements for translation, and the implementation specifics of the D-PRS gateway.

D-STAR is a digital protocol specification created by the JARL (the Japanese equivalent to the ARRL). The JARL has published the protocol and translated documents can be found online. The two key components to the D-STAR protocol are the high-speed data protocol, which is used for Ethernet encapsulation and transport (128 kbps), and the digital voice (DV) protocol, which incorporates FEC voice at 3600 bps and pure serial data at 1200 bps. This paper focuses on the data portion of the DV protocol. It is important to note that the DV signal is 4800 bps GMSK and the division between digital voice and serial data is fixed at 3600 bps and 1200 bps respectively.

There are no restrictions in the specification regarding data that can be sent down the data portion of the DV protocol. However, radio implementations have imposed their own restrictions, which must be considered anytime an author wishes to use that data channel. It is also important to note that the data channel has no inherent error detection or error correction. That is left to software authors to address. Finally, due to synchronization issues, the actual throughput of the data channel is less than 1000 bps. This should also be considered.

Icom DV Data Channel Implementation

All Icom D-STAR radios bring the DV data channel out via a standard asynchronous serial port (3-wire RS-232 on the VHF/UHF radios, USB on the 1.2 GHz radio using a USB-to-Serial driver). The restrictions on the data port in data mode are Xon/Xoff flow control and certain hex control codes for software control of the radios. The ID-1 uses 0xFE and 0xFD for control codes. There is no indication of source or destination callsign in the data stream presented to the serial port for received data (everyone sees everything with no source indication). There is no error detection or error correction on the serial data.

Icom implemented a GPS position exchange capability in their VHF and UHF radios using the DV data channel. This capability was never intended to be as robust as APRS but rather to give quick tactical position reporting to the D-STAR radios. The implementation basically sends the raw GPS strings (the operator can select which ones) along with an ID/message line via the DV data channel. The ID/message line consists of the 8-character radio call sign, a comma, and the 20 character GPS message (message C1), which is preset by the operator into the radio.

The position report can be set to send every X seconds or minutes, or it can be set to only send when transmitting voice. In either case when GPS is enabled, the radio sends the GPS & ID/message lines continuously while transmitting voice (PTT depressed). Transmitting voice via PTT does not reset the position report timer.

Because the GPS strings and the ID/message line are sent via the DV data channel, they appear as-is on any D-STAR serial port where the receiving radio is not in GPS mode. This fact is how D-PRS can be implemented with a D-STAR radio in standard (not GPS) mode.

D-STAR to APRS Translation

The first piece of D-PRS is getting the D-STAR position ports reliably translated into APRS format for consumption by APRS clients. The following key issues had to be addressed:

1. Reliable reception.

Because the DV data channel is not reliable (no CRC or FEC), a standard XOR checksum is implemented by placing the checksum in the GPS (C1) message using the same format used for GPS strings. The GPS strings automatically use the XOR checksum so no change was needed here.

2. Standard APRS format.

Received position reports could consist of multiple GPS strings with an associated ID/message field. This had to be reduced to a single APRS position packet dictating either a standard format or Mic-E. The standard APRS position format was chosen to reliably show position, course, speed, altitude, and comment in one packet.

3. Symbol selection.

A mechanism was needed to allow an Icom radio user to select which APRS symbol they want to use. This was implemented using the XYZ format for GP destinations (APRS specification) due to the limits on character selections on the radio messages.

4. Callsign-SSID creation.

D-STAR has no callsign-SSID equivalence to AX.25. The Icom standard for callsign settings is to use the Amateur's callsign followed by filler spaces and then placing a character in the eighth position. We replace the filler spaces with a single hyphen, which gives the appearance of a callsign-SSID with an alphanumeric SSID. This also dictates using APRS third-party packets for APRS network compatibility.

5. D-STAR is not AX.25.

As stated in #4, there is no relationship between AX.25 and D-STAR. As such, it was determined to use third-party packets on RF to denote the different networks. DSTAR* is used in the third-party header to denote a packet received or transmitted (see later) on the D-STAR network.

6. Potential flooding due to continuous positions during voice transmission.

Due to the continuous transmission of positions while transmitting voice on DV, a mechanism was put in place to only pass the first position seen during a voice transmission.

The protocol developed is as follows:

1. GPS strings preceding an ID/message line are ignored if the entire ID/message line (29 characters) does not pass the XOR checksum (start with zero). GPS strings with invalid checksums are ignored.

2. $GPRMC and $GPGGA strings only are translated providing a single standard position, course, speed, altitude, comment APRS position packet. A space always follows the 3-digit speed if a message or altitude is present. The altitude (/A=xxxxxx) string is always at the end of the comment field.

3. The APRS symbol is derived from the first four characters of the message line. The format is XYZ_ where _ is a space. XYZ are per the APRS specification for GPXYZ symbol definition.

4. The 4 character symbol at the beginning of the message and the *CS (checksum string)

at the end of the message are stripped and the remaining 13-14 character message is space trimmed and placed in the comment field if there are non-space characters present.

A sample APRS position gated to APRS-IS is:

KC5ZRQ-8>APJI23,DSTAR*,qAR,KC5ZRQ-2:!3330.35N/10150.87W>353/000 V82/145.67MHZ/A=003212

Note the DSTAR* for insertion to APRS-IS denoting the network the packet came from. There is a space between the 000 and the V82. The altitude field is at the end. If this packet were gated directly to RF via a stand-alone device, it would look like:

MYGATE>APRS,PATH:}KC5ZRQ-8>APJI23,DSTAR*:!3330.35N/10150.87W>353/000 V82/145.67MHZ/A=003212

MYGATE, APRS, and PATH in the RF header are set to the RF gateway's callsign, destination, and path respectively. Note the encapsulation of the D-PRS packet in the third-party format.

To have this APRS packet created, KC5ZRQ had to do the following three steps (quotes included for clarity, they are not programmed into the radio):

1. Program the radio MyCall to "KC5ZRQ 8"

2. Program TX message C1 to "LK V82/145.67MHZ*64"

This message is automatically calculated at **www.aprs-is.net/dprscalc.htm**

3. Program the radio to only transmit RMC and GGA GPS strings.

APRS over D-STAR

Gating APRS packets over D-STAR is not too difficult but there are some considerations. Primary is the fact that the DV data channel has no error detection or correction. Second, the Icom implementation does not allow for pure binary transmission due to the xon/xoff flow control and the reserved command characters described earlier.

The desire to gate APRS over the D-STAR DV data channel is found in wanting to connect APRS clients over the low-speed channel to APRS-IS or to an APRS RF network. This could be accomplished via two methods: emulate a TNC or emulate an APRS-IS server. Emulating a TNC would restrict D-STAR callsigns to AX.25 format, which is not desired. Emulating a TNC would also require simulating either KISS mode or simulating TNC commands to get MYCALL information (remember that the D-STAR protocol does not have station identification within the DV data channel).

Emulating an APRS-IS server allows flexible callsign definition (can match how the callsign of a D-STAR station running in GPS mode is converted to APRS). It does not require any modification to Internet-ready APRS clients to function. It provides the ability to have multiple clients connect to a single D-STAR radio.

To emulate an APRS-IS server, DStarTNC2 accepts TCP/IP connections and parses the login line. Just like APRS-IS, the client must supply a valid passcode for its callsign to achieve bidirectional operation. A read-only passcode (-1) can be used to monitor received APRS packets. DStarTNC2 passes both APRS packets and D-STAR GPS position reports as APRS positions to the client. DStarTNC2 passes packets from the APRS client to the D-STAR DV data channel after replacing the TCPIP* in the path to DSTAR*. This identifies the packet as originating on a D-STAR network instead of on APRS-IS.

There is on more very important piece of the gated APRS packets: an XOR checksum is appended to each line before transmission and stripped from each line before passing to the APRS client. This checksum is the exact same format as used in GPS strings (except this checksum covers the entire string) and the D-STAR ID/message line. It is important that this checksum never appears on APRS-IS or in an APRS network, as it would materially affect APRS dupe checking. javAPRSSrvr can act as an IGate for remote APRS clients and D-STAR GPS mode radios.

Summary

To avoid the issues seen a few years ago with Mic-E translation on APRS-IS, all authors must perform D-STAR to APRS translation uniformly. This makes the special formatting and interpretation of the C1 message critical. It also makes the translation to a standard position format critical to normal APRS operation.

APRS over D-STAR is not a translation process though the software that does this function can (and should) do the D-STAR to APRS translation for the APRS client. This is basically substituting the D-STAR DV data channel for AX.25. Because there is not built-in error correction or detection in the DV data channel, a checksum is added to APRS “packets” solely for transport over the D-STAR link. The checksum does not appear at the client or at the IGate.

D-PRS makes the D-STAR radios very effective tactical radios providing single channel data and voice operation. This eliminates cross-channel issues such as front-end overloading which are present in systems using discrete data and voice channels. D-PRS brings the power of robust APRS applications including extensive mapping options to the D-STAR networks.

###

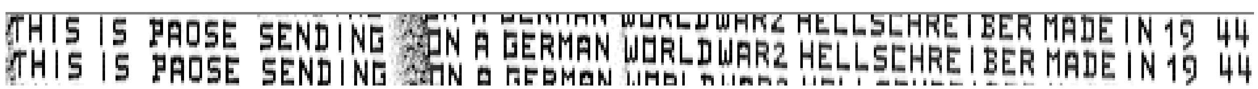
Are the Bands Going to Hell?

By Pete Kemp, KZ1Z, kz1z@arrl.net

Here is your chance to operate one of the "new" digital modes that has a lot of history behind it.

For the past six or seven years I've enjoyed the leisurely pace of Hellschreiber. This digital mode prints across your computer screen a bit like a fax. This is why Hellschreiber is sometimes dubbed the "fuzzy mode". If you would like to hear what a Hellschreiber signal sounds like go to: **www.101science.com/101digitalsamples/HELLSCHREIBER_SAMPLE.WAV**

Feld-Hell chugs along at 25 wpm, and some software allows you to print simple pictures like smiley faces and stars. You will find operators who like to rag chew, as well as many DX "quickie, 5x9 Good-bye" contacts. It always amazes me when a real DX station pops on. One afternoon I had a ZD7, St Helena Island, call me. It is thrill to be on the other side of a "pile up."



A Rich History

There is a rich history to this mode, which was originally patented in 1929 by Rudolf Hell. This digital system was developed for the German military. Hellschreiber was used extensively in portable field operations during WWII. This mode eventually was employed by some news services, remaining in use until 1980. Unlike teleprinters, Hellschreiber machines had only two moving parts, so were mobile and dependable. This method of transmission is also referred to as Field-Hell or Feld-Hell today. Hellschreiber is translated from the German, meaning Hell's writer.

You don't need a Hellschreiber machine from a flea market to get started. The combination of a computer, with sound card, software and a few wires is all you need to join in the fun. If you are currently using computer generated digital modes, such as RTTY, SSTV or PSK31, you are already capable of Hellschreiber. IZ8BLY, MultiPSK or commercially available MixW, may all be acquired via the Internet.

Anybody Out There?

Until recently, Hellschreiber enthusiasts were sometimes frustrated by the low level of activity in the mode. In March 2006 a Feld-Hell club was formed. In four months nearly 400 members have signed up. The interest has been sparked! The club has stimulated a renewed interest in the old fuzzy mode. Membership is free. Achievement awards are available. In an interesting twist, to earn an award log data is sent by mail. Once verified, a serialized electronic certificate is issued. You print out your own award. Thus, there are no postage, processing or production fees. The club's home page has links to a cluster that spot digital stations, a monthly club newsletter and weekly HF nets.

You can learn about the Hellschreiber mode, join the club and get links to software at **www.feldhellclub.co.uk/** . If you wish to join, send an e-mail to: **join@feldhellclub.co.uk** with your name, call and address. You will receive an FH# in a return e-mail.

In Hellschreiber QSOs are twice as good!

###

(Some) Encryption is Legal!

By Don Rotolo, N2IRZ, n2irz@worldnet.att.net

In the process of verifying some assertions made by a fellow Ham regarding the need for encryption on the amateur bands, I stumbled across something almost unbelievable: Part 97 permits some encryption, such as WEP on 802.11 gear.

As incredible (literally) as that statement seems, I firmly believe it to be true. Conversations with a highly placed official at the FCC, as well as at the ARRL and in the HSMM working group, support that conclusion. I can't mention any names, because anonymity was requested, but I expect to see a statement on the topic from some credible Hams any day now.

The basic premise is that Part 97 is unusually vague and specific at the same time. In virtually every case, Part 97 discusses practice and performance, but in Part 97.113(a)(4) it specifically prohibits "...messages encrypted for the purpose of obscuring their meaning". The key word here is purpose.

It is extraordinarily rare for Part 97 to regulate purpose, not practice, and we have to assume that the rules were written to mean exactly what they say.

So, if my purpose for encrypting a signal was, for instance, to comply with Part97.113(e) (stating

"no station shall retransmit programs or signals emanating from any type of radio station other than an amateur station...") because your 802.11g Gear is surrounded by Part 15 users, then it's perfectly legal. If it so happens that to maintain that compliance you need to encrypt everything, well, so be it.

There are other instances as well. Think about it for a while, and you will come up with other purposes for needing encryption that do not involve specifically the obfuscation of meaning (although that may happen to be a by-product). Some of these purposes can be argued - privacy is a good example – but others are clearer. (Note: This isn't limited to 802.11, it applies equally to HF, so long as you keep the communications within the country. Some international agreements prohibit encryption).

Sure, there are caveats. You need to comply with 97.309(a)(4), about the modulation scheme being publicly documented, (I'm pretty sure 802.11 and WEP both comply), plus you certainly have to ID every 10 minutes. I believe it would be good amateur practice to make a note of the encryption key in your station log, too.

From the FCC's point of view, they really only need to know who is doing the transmitting. For that, I'd think setting the SSID to your callsign would be enough. If they also need to know what it is that you're transmitting, they can just ask, or even easily record the signal in full bandwidth, and stop by later to ask for the decryption key so they can play it back and see what it was. Surely the Government can do this even without your assistance, but I seriously doubt anyone would refuse to hand over the key.

As far as content is concerned, use the Grandma Test: If you wouldn't be proud to have your grandma hear what you're sending, then you probably shouldn't.

Surely this issue will be controversial, and although I can't name names, I heard it with my own ears: Some encryption is perfectly legal under Part 97. If you remain doubtful – I don't blame you – then wait a while and see what comes of this fairly recent information. For the rest of us, though, there's nothing standing in your way.

###

Digital Voice Using 100-Hz Bandwidth

By Mike Lebo, N6IEF, mike-lebo@ieee.org

Objective: To outline the steps needed to achieve digital voice using 100-Hz bandwidth with the intent to develop software that could be used by amateur radio operators.

Overview of hardware: Voice will enter a computer from a microphone from the microphone-input of the sound card when the space bar of the keyboard is held down. It will be processed and sent out as a Phased Shift Keying (PSK) audio tone from the line-output of the sound card to the amateur radio transmitter. Using Signal Side Band (SSB) modulation, the PSK audio tone will be converted into Radio Frequency (RF) PSK and sent out through an antenna. Another antenna and amateur radio receiver at a different location will receive this RF and convert the PSK RF into a PSK audio tone. This PSK audio tone will go into the line- input of the sound card of the other computer, where it will be processed and the voice will be played on the computer's speakers. This hardware is readily available at most ham radio stations.

Steps need for the computer processing during transmit:

1. The digitized audio from the microphone will be compared to a list of 44 digitized audio clips called phonemes. While the next block of digitized audio from the microphone is being compared, a histogram of the best five matches from the first digitized audio will determine. The best fit from this histogram will be found by comparing the five phonemes at different speeds.

2. Once a phoneme is identified, a unique coded sequence will cause a PSK audio tone to be made and sent from the line out of the computer sound card.

Note: The rate at which the code is sent out will equal the rate at which the audio from the microphone is received, but it will be delayed by one-half second to allow the computer time check its look-up tables.

3. If the audio level drops below a set threshold, a code of 111000 will be repeatedly sent until the amplitude of the audio goes above the threshold.

Steps need for the computer processing during receive:

1. The audio from the ham radio receiver will be sent to the line input of the sound card and will be digitized through a process like the readily available PSK-31 software. A waterfall will display on the computer monitor and through an algorithm using Digital Signal Processing (DSP), a digital 100 Hz bandwidth filter will reduce the noise of the 2400 Hz filter of the ham radio receiver.

2. The PSK audio tone will be detected and converted into a code, which will be compared to a look-up table of audio clips. Since the look-up takes time, a one-tenth second delay will be added from the time the PSK audio tone is received to the time the audio clip comes from the speaker.

3. The audio clip will be stretched in time and played on the computer speaker until the next audio clip is played. Note: No sound will be played when the code of 111000 is detected.

Generations of the transmit phonemes: Since each person sounds different from another, it is clear that the computer must recognize the unique phonemes from the person operating the digital voice using 100 Hz bandwidth software. The software must be able to teach itself the phonemes. Once learned, the computer will recognize that person's voice.

1. The initial phonemes setup will be done by having the person read words shown on the computer monitor and speak these words into the microphone of the computer. Whenever the person speaks into the microphone, they must hold down the space bar. This must be done in a very quiet place to eliminate background noise.

2. Each word will be spoken three different times: once normally, once loudly and once quietly. This will accomplish two different things. First, it will be used to calibrate the DSP automatic speech compression algorithm to constantly adjust the microphone gain for fixed output level. I believe the variations of voice amplitude add very little to the context of speech and they will not be sent or played at the speaker of the ham radio receiver. Second, parts of these words will be used to generate the 44 digitized audio clips called phonemes.

3. These phonemes will be combined to form phrases, which will be played over the computer's speakers. The person will then repeat these phrases into the computer's microphone, while holding down the space bar. Each phrases will be spoken three different times as in step 2; once normally, once rapidly and once slowly. The initial group of 44 digitized audio clips will be replaced by 132 digitized audio clips. This process will be repeated and averaged until the computer has all the digital audio clips need to always understand the person.

Although there are three digitized audio clips for each phoneme, only one code will be generated for that phoneme.

The code used to send and receive the PSK tone: The 44 phonemes (see **www.btinternet.com/~ted.power/phon00.htm**) will be represented by a code made up of 1's and 0's.

Most of the characters will be 1's to offset the 0's that will be added to stretch the time between phonemes. All code groups will start with a 1 and end with three or more 0's. Since phonemes are grouped by the shape of the mouth, the codes used in one group of phonemes should be as different as possible from other groups. Example, a "b" sounds like a "v" and their codes should be similar, but they sound much different from the sound of an "m" which should have a much different code. Some phonemes are longer then others and they should have a longer code. Others are short like the sound of the letter T, which will have a short code. There should never be a code with 0001 in it. When a code with 0001 or any other unrecognized code is detected at the computer of the ham radio receiver, an error-correcting algorithm will be used to take a best guess at what the code should have been. The 44 of the following 51 codes will be used with seven as spares.

```
1000       11000      101000     1001000
1011000    1101000    1111000    10011000
10101000   10111000   11001000   11011000
11101000   11111000   100101000  100111000
101001000  101011000  101101000  101111000
110011000  110101000  110111000  111001000
111011000  111101000  111111000  1001001000
1001011000 1001101000 1001111000 1010011000
1010101000 1010111000 1011001000 1011011000
1011101000 1011111000 1100101000 1100111000
1101001000 1101011000 1101101000 1101111000
1110011000 1110101000 1110111000 1111001000
1111011000 1111101000 1111111000
```

Note: The code 111000 is a special code for no sound and is not used by the phonemes.

As shown, it is the fastest speed for each phoneme. With a 100 Hz clock, 10 or more phonemes could be sent every second. Just think about moving your mouth to 10 different position every second. I can't do it.

By adding one or more extra 0's to any code, the length of that phoneme will be stretched by increments of 1/100 of a second. This is very important because voice is contently changing in speed. The original set of 44 phonemes will be expanded to over 440 phonemes.

Let's show an example of how each code could be expanded to a very large set of new codes. The code 1000 is the smallest, but by adding a 0 it becomes 10000. It is the same phoneme, but stretched by 1/100 of a second. The number of 0's added is dependent on when the next phoneme is detected at the transmitter and that code is sent. At the receiver the look-up table finds the phoneme when three 0's in a row are detected. Another look-up table then finds the correct audio clip based on the number of additional 0's. This will account for all variations of voice speed without extending the 100-Hz bandwidth.

The 100 Hz clock: It is easy to make the 100 Hz clock used to send the PSK audio tone at computer of the ham radio transmitter. But at the computer of the ham radio receiver, a new 100-Hz clock must be made by synchronizing the new clock to six times the frequency of the special code 111000. A very narrow band digital filter will detect that unique frequency with very little noise. If the space bar were pressed just before speaking into the microphone, this special code would be sent.

The receiver phonemes: Since each person has a unique set of phonemes, there is no way for the computer at the ham radio receiver to know how the make received code sound. This is the normal case for ham radio transmissions. So to make this more fun, 12 different sets of audio clips will be available by selecting F1 through F12 on the keyboard. These will be from the sound of a little girl, to that of an old man and anything in-between.

Improvements that could be made after the system is working: One of the problems in selecting the code for the transmit phonemes is the error contributed by the background noise picked up by the microphone. To reduce this noise, two microphones should be used, one with the person's voice plus the background noise and the other with just the background noise. The computer could easily subtract the background noise. Computer sound cards are equipped for stereo, so that should be no problem.

The computer at the ham radio transmitter will learn exactly what the phonemes are for the person sending the transmission. This set of phonemes and the sending station's call sign could be e-mailed to the digital voice using 100- Hz bandwidth software at receiver's computer. When the computer at the ham radio receiver detects the code for the phrase "This is (followed by the transmitting call sign)", it will automatically switch to the e-mailed set of phonemes for that call sign. That way the sound from the speaker of the computer at the ham radio receiver will sound like the voice of the person doing the transmitting. This would be useful for three-way conversations or nets.

Implementation of the system: Since this could be used all over the world, the software must be available on-line.

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