HPSDR.org – An Open, Collaborative Community to Experiment with High Performance Software Defined Radio

One of the most exciting new technologies to emerge for amateur radio experimenters in the past few years is Software Defined Radio. Gerald Youngblood's (K5SDR) QEX series "An Software Defined Radio for the Masses" and the Flex-Radio SDR 1000 showed the possibilities of the technology for experimenters. Tony Park's (KB9YIG) SoftRock line of receivers has brought SDR technology to 1000's of amateur experimenters.

HPSDR.org is an effort started by a number of SDR enthusiasts that wanted to experiment with SDR and try to build a high performance SDR. Many of the initial HPSDR contributors have been involved with the SDR 1000 community and the Soft Rock community the last few years and would like to try and incorporate some of the lessons learned from those radios as well as newer technology.

HPSDR.org is an informal organization; composed of people interested in developing, building and experimenting with high performance SDR. The group has a web site, mailing list, wiki and SVN server. Folks interested in a particular project can propose it on the mailing list, find folks interested in working on it on the list, document it on the wiki and manage code development using the SVN server.

The first HPSDR project was the Atlas board currently available from TAPR. The Atlas board is a passive back plane that other HPSDR boards are plugged into. Most boards for HPSDR will have a connector that mates with the Atlas so we can take a building block approach to building projects.

The next two boards from HPSDR will be the Ozymandias USB2/IO board and the Janus soundboard. Ozymandias provides local logic on the Atlas bus, and connects back to a PC via a USB 2 connection. The board has an FX2 micro controller to handle the USB 2 connection and a large Altera FPGA to provide logic and control. A DB25 and DB9 connector are provided on the Atlas board for connection of other devices. Phil Covington (N8VB) did all of the design and board layout work on the Ozymandias board.

The Janus board is a high quality sound card designed specifically for software defined radio applications. It has a 24 bit 192khz AK5394A A/D converter for digitizing down sampled RF. In an SDR the A/D converter is one of the most critical items determining the performance of the receiver; the AK5394A is probably the best audio codec available today (See http://hpsdr.org/wiki/images/4/46/Janus-DCC-2006-paper.pdf for details on the different A/D converters tested). The Janus board also contains a TI TLV320AIC23B 16bit 48khz codec for handling microphone input and speaker output, as well as an FPGA based PWM D/A converter for transmitted signal. There is provision on Janus for phase locking the codec sampling clock to a 10 MHz reference signal for excellent frequency accuracy. There's also a small CPLD to allow for soft configuration of what lines to use on the Atlas bus as well as limited local logic on the Janus board itself. Phil

Harman (VK6APH) is the designer behind Janus with some Verilog and software work from Bill Tracey (KD5TFD). Lyle Johnson (KK7P) did the board layout work.

As of this writing, Ozymandias and Janus are up and running and have been through two revisions. Initial testing is showing the sensitivity of the Janus board to be excellent, getting an ENOB of 20. At the time of this writing, TAPR is looking into quotes on getting manufactured Janus and Ozy boards. With a bit of luck and favorable parts availability more information on availability of boards should be in the next issue of the PSR.

There are some additional HPSDR projects currently under active development. One of these is the Mercury receiver being worked on by Phil Harman (VK6PAH) and Phil Covington (N8VB). Mercury is a direct sampling receiver based on an LT2208 16 bit 130 Ms/sec A/D converter. The data stream from the converter is to much to send to a PC to process via USB 2, so an FPGA on the Mercury board will be used to decimate, and downconvert portions of the 65 Mhz of spectrum the A/D converter sees to send to the PC for processing. Phil Harman has jury rigged an LT evaluation board and Ozymandias to build a prototype Mercury receiver and reports good results with it feeding a slightly modified version of PowerSDR.

To go with the Mercury receiver, Phil Harman is also working on a transmitter board called Penelope. This board is in the early stages of design and prototyping. The design at the moment calls for an FPGA to do upconversion and interpolation to feed a hi speed D/A converter, followed by switchable bank of low pass filters and a 1 watt power amplifier. The board also contains provisions to phase lock a 10 MHz reference to the D/A clock as well as provision for mic and line in inputs. One interesting experiment going on with the Penelope prototype is use of an Envelope Elimination and Restoration (EER) power amplifier.

Along a somewhat independent development track is the Odyssey project. This is a low power handheld SDR implementation based on a QSD, QSE and dsPIC33 targeted at SuitSat2. This project is composed of 4 boards: Siren, Odysseus, Cyclops, and Circe. Siren is the basic QSD/QSE based transceiver with a dsPIC33 for DSP work. Odysseus is a PIC24 based board that encodes packet and SSTV as well as providing recorded voice to be fed to Siren. Cyclops is a video capture board to provide video for Odysseus to SSTV encode and Circe is a mixer/amplifier board to 2m transmit and 70 cm receive. The designers of Odyssey are: Joe Julicher (N9WXU), Steve Bible (N7HPR), Frank Brickle (AB2KT), Bob McGwier (N4HY), and Lou McFadin (W5DID)

With the development of Janus and Ozy wrapping up, these boards should be available to the community soon. I'd encourage folks to get involved and experiment with this technology when it becomes available. There are excellent opportunities to experiment with hardware, firmware and software with these boards. As a community we certainly have the skills and capabilities to build an excellent High Performance SDR – who said the age of experimentation in amateur radio was over, we're only just starting!