## SOFTWARE DEFINED RADIO - THE FUTURE MANTRA

**Unity Is The Motto**

# MEETING AT VIGYAN PRASAR



## PARTICIPANTS

1) VU2ATN, VU2OEC, VU2XD, VU2BSB
2) VU2BSB, VU2DS, VU2BDX, VU2PSQ, VU2LMZ, VU2TU
3) VU2CCT, VU2WX, VU2BKM, VU2ATN, VU2OEC, VU2XD, VU2BSB, VU2DS, VU2BDX, VU2PSQ VU2LMZ, VU2TU
4) VU2GMN, VU2MUE, VU2BDX
5) VU2MUE, Sandeep APRS Demo and Presentation
6) VU2VP, VU2GMN, VU2VBK, VU2SDN dais
7) VU2VP, VU2GMN, VU2VBK, VU2SDN, VU2NTT, VU2KD, VU3ORN, VU2TPR, VU3SLJ, VU3AKW, VU2MB, VU3FUN, VU3GTF, VU2AMV

## PRESIDENT'S REPORT

It has been a very busy time for your Governing Council over the past few months.

After the VU7LD expedition there has been a lot of work to be done- the QSL process was in full swing, letters of thanks had to be sent to all the contributors, articles to be written to publicize the event in various magazines, mementos to the large contributors etc. Articles appeared in almost all the major ham radio magazines world wide.

For the first time ever, laminated Life Member cards were made and despatched to all Life members. This has been very well received by the members. We urge corporate members to convert to Life members as it is much more convenient.

Contests are being promoted by ARSI in a big way and you will receive details of many new contests to keep the air waves humming- Arasu is thinking of innovative contests to bring in members back on air.

This committee has been in office for two years now and the AGM is fixed for the 11th of August 2007 at Bangalore and by the next HRN a new committee would have taken over. I am sure that they will continue to move ARSI forward during their term and I wish them all the best.

I would like to thank all the GC members for their work, and other members for their suggestions and cooperation over the past two years.

## THE EDITOR SPEAKS

Greetings from a very wet Mumbai!!. The Monsoon season is on and with it come all the problems. All in Mumbai are paranoid about water flooding the streets and the resultant chaos. This time as before, all hams in Mumbai are on standby to help the civic authorities in communication. The members of the Thana Amateur Radio Association and Mumbai Amateur Radio Society are all equipped and ready.

The excitement from VU7LD has subsided though it is still discussed on air, whenever I am on radio! The world is looking out for more such expeditions from India.

Personally, I think all of us need to get more adventurous. That is one aspect of ham radio which we seldom explore. We are content with the fact that we operate radio from our shacks. We should venture outside with our gear. There are immense possibilities of enjoyment with family and friends. Field Day is one event in the Amateur Radio calendar which commands a huge popularity. Unfortunately the VUs have no presence in this event. This is one event which needs to be promoted.

VU2UR, is coming up with some innovative contests and I hope all VUs will participate.

This issue of HRN deals with the new concept of SDR. I think it will go down very well with the younger generation for whom the computer is not a machine but a way of life. Though technically I have still not been able to digest the concept, I am happy if it attracts youngsters into hamdom and injects freshness into the hobby which is slowly being typecasted as a hobby for "Oldies"!

But along with the concept as always, the availability of the kits is an important issue. OM Rahul, VU2WJM is very enthusiastic about the concept as well as the production of kits.

I will going on a trip to Kailash Mansarovar and will be away for the whole of July. This issue will reach you when I am up there somewhere in the mountains! If you don't hear me on air after July, you know where I disappeared!

Stay cheerful, love your radio and never give up on Hamradio, the King of hobbies.

*Sarla*

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| Membership Category | Admission Fees(Rs) | Annual Fees(Rs) |
|---|---|---|
| Patron | 25,000 | Nil |
| Life | 4,000 | Nil |
| Corporate (Individual with Valid Amateur Licence) | 50 | 250 |
| Corporate (Club, Society or Institution with Licence) | 100 | 1000 |

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A Field Trip was organized by the **Thana Amateur Radio Association** on 13th May 2007. Participants in this event were Mr. Milind Korde - VU2IZO, Mrs. Sarla Sharma - VU2SWS, Mr. Nandu - VU2NKS, Mr. Vidyasagar Ubale - VU2UVS, Mr. Shekhar Purshottam - VU3JEG (Nasik), Mr. Anil Rege - VU2CVD (Nasik), Mr. Manoj Joshi - VU3MWJ (Nasik), Mr. Sailin Gudka - VU2SGW, Mr. Makrand Chitnis - VU2YAG Mr. Omkar Karve - VU2OSK, Mr. Prakash Nitsure - VU2PJN, Mr. Paresh Mehta - VU2PQM, Mr. Pranav Patel - VU2PNV, Mr. Dilip Vyas - VU2DVX, Mr. Rohit Purohit - VU2TOO, Mr. Huzefa Merchant - VU2HIT, Mr, Vijay Motwane - VU2VVP, Mr. Ashutosh Tulpule - VU2ATV, SWLs Mr. Uday Deshpande, Mr. Bijoy Philip, Mr. Jayant Kale, Mr. Rahul Vira, Mr. Meghan Patankar. A few family members of the participants were also present. It was a first experience of operating radio for many of the participants, who had received their call signs very recently. One HF and VHF station was set up with homebrewed antennas. Experiments were conducted on SSB, CW and digital modes.

On his way back to Chennai from Nasik, the President of ARSI, Mr Gopal Madhavan, VU2GMN met the members of the Thane Amateur Radio Association(TARA) The meeting was organized at Hotel Sharanam and was attended by SWLs and call sign holders of the club. Mr Milind Korde, VU2 IZO, secretary of TARA welcomed the ARSI President with a bouquet and a gift. Issues like club membership to ARSI and other topics like the future of Hamradio were discussed. Lunch was organized at the same venue.

A meeting of the radio amateurs was organized by **Vigyan Prasar** (Department of Science & Technology, Govt. of India, New Delhi) jointly with ARSI (Amateur Radio Society of India) on April 15, 2007 (Sunday). The meeting was presided over by Dr.V.B. Kamble, VU2VBK, Director, Vigyan Prasar & Scientist 'G'/Adviser, Dept. of Science & Technology, Government of India. Chief Guest of the Meeting was Shri Gopal Madhavan, VU2GMN (Chennai), President, ARSI, Dr.V.P.Sandlas, VU2VP and Shri Sahruddin, VU2SDN shared the dais. Other hams at the meeting were Shri Atanu Dasgupta, VU2ATN, Shri Meher Bhan Singh (Bhanu), VU2MB, Shri Bharat Balsavar, VU2BDX, Shri Daljit Singh, VU2DS, Shri Balwant Singh, VU2BSB, Md. Sofi, VU2KD (Ex-VU2ZUS), Shri Karan Bakshi, VU3GTF, Shri S.P. Sharma, VU2WX (Lucknow) Shri Rajesh Chandwani, VU2OEC, Wing Commander Prashant Karkare, VU2PSQ Shri M.M. Kumar, VU2XD, Shri Rajiv Kumar, VU2VTH, Shri T.P. Sinha, VU2TPR Shri Chandrima Roy, VU2CCT, Shri Vinay Kishore Agarwal, VU2LMZ, Shri Anil Soni, VU2AMV, Shri Ashok Sapra, VU3AKW, Shri A. Ray, VU3ORN, Ms. Anu Sharma, VU3AXS, Shri Rajesh Bakshi, VU3FUN, Shri Rajani Mohan, VU3CAV, Shri Neeraj Sharma, VU2NTT (Lucknow), Shri R.K. Kutar, VU2TU, Shri M.S. Kamath, VU3SLJ Shri B.K. Mitra, VU2BJM, Shri Sandeep Baruah, VU2MUE (Ex-VU2MSY) Prior to the meeting, on Friday, April 13, 2007, Shri Gopal Madhavan, VU2GMN, met the

Joint Secretary, Ministry of Home Affairs and the Secretary, Ministry of Communications & IT and appraised them about amateur radio and the grievances faced by radio amateurs due to the age old rigid amateur radio rules in India. ARSI submitted different petitions to both the ministries. During the meeting on Sunday, all these issues were discussed at length and lectures, presentations, technical demonstrations, video show etc. were organized. Shri Sandeep Baruah, VU2MUE (Operational In-Charge of Club VU2NCT and Senior Scientific Officer/Scientist C, Vigyan Prasar) demonstrated the APRS technology including its web integration(http://www.vigyanprasar.gov.in/ham/aprs/). An emergency ready station setup was demonstrated. The station consisted of a Kenwood TM D700 Data Radio, Arrow Satellite Yagi, GARMIN GPS, Batteries with Solar Panel power backup through charge controller and PFD (Personal Floatation Device). He also deliberated a presentation on the present status of amateur radio in India. In his presentation, the different issues involving problems of amateur radio promotion in India were highlighted. He apprised the participants about the recent upgradation of VU2NCT Club station with Satellite Communication equipments and antenna systems with full automatic Az-El tracking(http://www.qsl.net/vu2msy/vu2nct/). Shri Gopal Madhavan apprised the participants about the BPL (Broadband over Power Lines) threat to hams and other radio frequency users (e.g. Police, Army, para-military forces, aeronautical communications etc.). He expressed his concern that if a technology which was not conforming to IEEE standard was implemented in our country it would effect our HF radio communication systems in a severe way in the coming days. "We have a meagre existence and if these projects are going to be implemented without adequate interference reduction technology, the insignificant bit of us would be totally wiped out of this country!" -He said. Dr. V.P. Sandlas, VU2VP deliberated at length the different issues concerning the welfare of amateur radio in India. Shri Gopal Madhavan (VU2GMN) presented a video documentation on BPL (Broadband over Power Line) interference to HF (High Frequency) Amateur Radio Band. A portion of the meeting during the video show may also be seen at :Http://www.youtube.com /Watch?v=KBHOQKEtYI8 Shri Bharat Balsavar, VU2BDX, deliberated a presentation on the role of hams during emergency disaster communication and apprised the participants about the Mock Drill communication exercise carried out by radio amateurs in NCR region in the recent past. He also apprised the participants about the coordination effort of ARSI Gurgaon Chapter with the NDMA (National Disaster Management Authority) for emergency communication.Shri Sandeep Baruah, VU2MUE informed the participants about the ham radio training programme.................................... (http://www.vigyanprasar.gov.in/dream/july2006/Eng

lish.pdf) conducted by Vigyan Prasar in Uttarakhand (erstwhile Uttaranchal) where 33 trainees (all National Service Scheme Volunteers from 13 districts of Uttarakhand) last year. He expressed his concern that though the training was conducted to realize the goal of establishing an emergency radio communication network across Uttarakhand , the successful candidates were still not issued with their licences by the licencing regulatory body. "It is now nearly 10 months running still no licences are issued to them by the licencing authority. This is an issue concerning the safety and welfare of the people of a state which is very much vulnerable to natural calamities and emergency radio communication is of utmost importance." -He said.

**Hamsat** will be be celebrating its 2nd birthday on 5 May completing 2 years of healthy & successful operation rendered to Hams worldwide. VO52 is considered the best Leo satellite. There is always plenty of action on VO52, with many many stations active during every pass. It allows access to the satellite with low power and even simple vertical antennas. It allows operation of many stations.at the same time. The downlink signal is much stronger then any other LEO around. It allows CW, SSB and with some manouvering SSTV and RTTY, and possibly PSK (good control of the frequency required there). It is possible also to operate via this satellite from a mobile set up.

**The Kerala Amateur Radio League** held its annual General Body meeting on 25th February 2007 at DIANA Karunagappally in Kollam Dt.The following hams were elected as office bearers for the next two years. President:Om Ganesh VU3GEN, Vice presidents:L.V,Sharma VU2LV, H.S.Moni VU2HSM, Secretary:Devadasan VU2NDA.

The society will be conducting its monthly meeting at Kollam on the first Sunday of every month.The society will be taking part in the temple festival at Kollam to give VHF support.The quarterly magazine will be published regularly hereafter. Plans are afoot to revise the correspondence course and bring it up todate.

A lecture and presentation on ham radio [Amateur Radio] at BITS Pilani [ Birla Institute of Technology & Science, Pilani was made by VU3WJM, OM Rahul on March 25, 2007. Air support was given by OM Datt, VU2DSI [ Ahmednagar, Maharashtra ] and OM Kumar, VU2XD [New Delhi]. A demonstration of various ham radio technologies were also given to the students of the Electronics Department. The audience included Dr. G. Raghurama, Deputy Director, Dr.M.N. Satyanarayan [ Professor, Electronics Department ], Dr. V.K. Chowbey [ Head of the Department, Electronics ] and Dr. Vimal Bhimot [ Prof.Electrical Engineering ] Plans were made to reactivate the defunct ham radio club station of BITS Pilani [ VU2BRC ]. The technologies demonstrated were Morse Code, Packet Radio, SSB Voice Communication on HF band, . APRS [Automatic Position Reporting System: a graphically represented digital mode of communication] Equipment used were - ICOM IC 718 HF transceiver, MFJ 941C , ICOM IC W32A handy, 13.8 Volt 30 Ampere light weight SMPS power supply, One 12 Volt 8 Watts Solar Panel with 12 Volt Charge Controller and

Battery backup [ a 12 volt car battery as power backup. Students were presented with a set of literature related to low-cost homebrewing, one CD on Ham Radio, One Gordon West Morse Code learning CD, One Morse Code learning Audio cassette and a PCB with torroids/coils for assembling a low cost 20m band SSB transceiver.

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# Antennas facts and fallacies

## Yagi Antennas

When you read the data about that antenna you have just bought ,how much of it can you believe? An HF Yagi antenna usually quoted as giving 7 or 8 dB gain is probably meaningless. Firstly the gain must be quoted against a known reference source. This is usually a dipole but is sometimes an "Isotropic source. Now a dipole has a gin of 3dB over an isotropic source, so take of 3dB to start with. Let's look at an example.

A "Supadinga 3" has an advert stating an 8.5dB gain. Ok, first there is no mention of the reference. We can safely assume that it means they don't want to say that the reference is an isotropic source. Which means that the actual gain is more likely to be in the order of 5.5dB over a dipole. This is more like it. Although the theoretical gain of a three element mono band Yagi is in the order of 7.5 to 8.5 dBd (the d means reference to a dipole) in practice, 6dB is the best you would get in actual ideal home conditions. Remember we are talking mono band antennas not tribanders.

Adding extra elements to the 3 element will only give an extra 1 dB of gain. To get more gain it is better to stack one antenna above another of similar construction. This will give in the order of an extra 2 to 3dB gain, totaling up to 8dBd.

Yagi antennas should be tuned for maximum forward gain rather that best front to back ratio.

## Gains

A power gain of 3dB is like doubling your power output. A 6 dB power gain is like increasing your power output by 4 times. Now we are talking 100W in to a dipole. Your choice. An increase in transmitted power from 100 W to 400 W gives an increase of only one S point at the receiving station.

Repairing Ham equipment at Hotel Pokhran Fort


VU2PSQ (Prashant) in Mobile Ops


VU2WX (Sharma) near the Stage
Commander's Chevrolet Forester

The locations of all the stages were in the interiors of Bikaner, Jodhpur, Jaisalmer and Ajmer District, which gave us the opportunity to view the flora & fauna (Black-bucks; Chinkara; Peacocks) of Rajasthan. Hams were really filled with feeling as to how the soldiers of Indian Army crisscrossed the lengths/breadths of huge Rajasthan and lived there for long periods. All the three teams were stationed in the palaces/havelis/heritage hotels of Rajasthan like Lal Niwas in Phalodi, Jodhpur District; Laxmi Niwas Palace, Bikaner; Pokhran Fort, Pokhran; Fort Pushkar, Pushkar, Ajmer District and The Clarks, Jaipur. Hospitality was commensurate to the RTDC slogan "Padharo Mharay Des" with warm welcome, ethnic Rajasthani food and excellent service. Team-1 once developed some technical problem with their ICOM VHF base mobile, which was rectified with the help of team members VU2PSQ, VU2WX and VU2BDX. The Rally organizers were licenced their own frequency by WPC and all equipment had to work on that. The competitive sections were all on unpaved roads, all sizes of pits sometimes full of water yes, in

Rajasthan due to recent North West Monsoon rains. Each and every happening was radioed by hams loud and clear to the main station/relay station, thus giving the clear picture to the COC of the Car Rally. The four days of motor sports radio communication flew by as though in the blink of an eyelid. Hams braved all the weather conditions, early wakeups and late sleeping time. What to say of hams that were in the stage of Sambhar Salt Lake near Phulera in Jaipur District. It looks like a dried lake with a dry white coating of salt but actually vehicles go skidding and twist and twirl due to the wet and soft mud below. Holding oneself and handling radio communication at the same time was something to experience. The event was to end in Jaipur with an awards ceremony at Hotel Clarks. However, the next day being a weekday and as most had to go to morning QTH, all the hams decided to hit the home QTH by the end of the day. By 2200 hrs on Sunday 18-Feb-2007, all the eight hams were asleep with their radio gear back in the shack and memories of the week that flew by.

SIMPLE POWER METER WITH DUMMY LOAD - By Rahul Srivastava, VU3WJM

The design is based on a kit sold by Elecraft. The RF voltage developed across 50ohm resistor combination is rectified and measured using a multi meter. Cheap digital ones from China are highly suitable.

Dummy load consists of series parallel combination of 32 nos 100 ohm 1W carbon resistors. (Don't substitute a higher wattage wire wound one). This gives us a non inductive 50 ohm load. A germanium diode from the centre tap of combination gives us potential for power measurement. Original design was capable of measuring 20W max..

With many of us using MOSFET based linear at 30 plus voltages slightly more power handling was required. This design can handle 35-40W for short durations. DC potential developed at TP1 can measured on a multimeter and corresponding power could be derived from look up chart given.

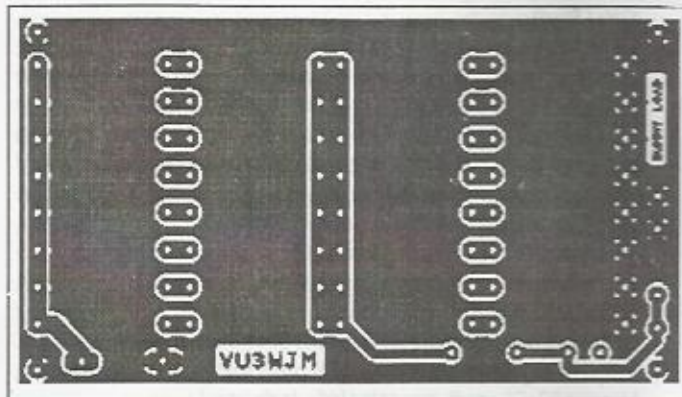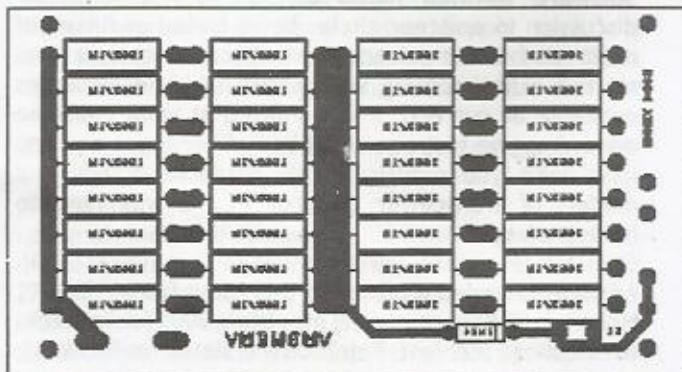Schematics:
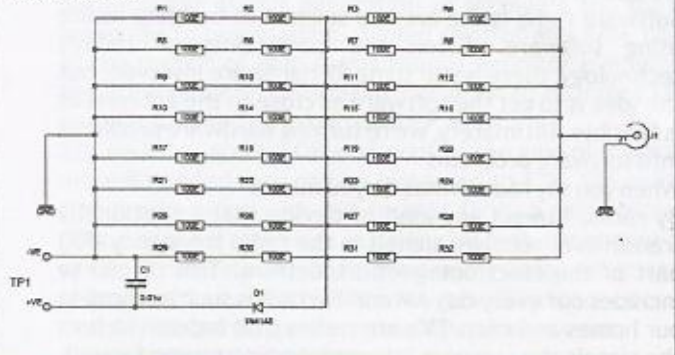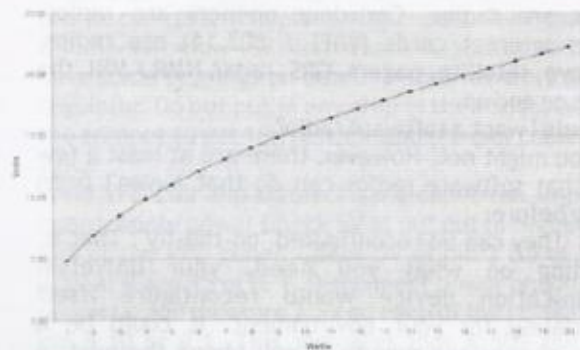




Look up Table



PCB Design



Component Layout

Alternatively power can be calculated from the formula:

$$\text{Power} = ((\text{Volt at TP1} \times 1.414) + 0.2)\,\text{sq} / 50$$

0.2V is taken as general value for the diode drop it will vary from device to device. For silicon diodes like 1N4148 it will be 0.7V.

The circuit is simple enough to be taken up by anyone. It can be assembled over a piece of scrap copper clad PCB material. Care should be taken to keep component leads to minimum. For purists I am also including a PCB layout.

The accuracy of meter is within 10% and it should work beyond 2 meters. No Bird this one but good enough.

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# COVER STORY - SOFTWARE DEFINED RADIO

## By Rahul VU3WJM

### A General Know-How What is software radio?

Software radio is the art and science of building radios using software. Given the constraints of today's technology, there is still some RF hardware involved, but the idea is to get the software as close to the antenna as is feasible. Ultimately, we're turning hardware problems into software problems.

When you say radio, what do you mean?

By radio, I mean any kind of device that intentionally transmits or receives signals in the radio frequency (RF) part of the electromagnetic spectrum. This of course includes our every day AM and FM radios such as those in our homes and cars. TV's are radios that happen to turn the signals they receive into moving pictures and sound. Cell phones and cordless phones are radios. Garage door openers are radios. Car door openers are radios. Wireless internet cards (WiFi / 802.11) are radios. Shortwave, satellite, pagers, GPS, radar, NMR / MRI, the list goes on and on.

Why would I want a software radio?

Well, you might not. However, there are at least a few things that software radios can do that haven't been possible before:

·       They can be reconfigured "on-the-fly". That is, depending on what you need, your universal communication device would reconfigure itself appropriately for your environment. It could be a cordless phones one minute, a cell phone the next, a wireless internet gadget the next, and a GPS receiver another.

·       They can be quickly and easily upgraded with enhanced features. In fact, the upgrade could be delivered over-the-air.

·       They can talk and listen to multiple channels at the same. OK, so what do I care? Imagine you're a cop, or a fire fighter, or an ambulance driver. Today there are many places where public safety people from one organization can't talk to another. The locals can't talk to the emergency crew from the next town because they've got different kinds of radios. Software radio solves this problem.

·       We can build new kinds of radios that have never before existed. Smart radios or cognitive radios can look at the utilization of the RF spectrum in their immediate neighborhood, and configure themselves for best performance.

What's the story with free software radio?

First off, let's make sure we're on the same page with regard to free software. Free software means the user has the freedom to run, copy, distribute, study, change and improve the software. Access to the source code of the program is a precondition for this freedom. Without the source code there is no straight forward path to study or improve a piece of code.

What's so good about that?

### Education

Taking things apart and seeing how they work is one of the time tested ways to get a real education. Free software encourages this, and makes available complete, working systems, some of breathtaking complexity, for study by anyone who chooses. The only cost is your time.

### Innovation, Innovation, Innovation

An organization's first job is to ensure its survival. This puts a mighty constraint on what research or development a company will undertake. A company will not "innovate itself out of business". Free software developers, operating for the most part under a different set of constraints, are free to design new systems that challenge pre-existing assumptions and business plans. Discontinues innovation is possible.

Bringing the free software ethic to hardware

Traditional radio design is a hardware intensive process that typically results in a closed proprietary system. These systems are closed to examination, study or improvement by outsiders, that is, people who weren't on the design team. By moving more of the radio design into software, bigger portions of the system are made available for study, tinkering and improvement.

In addition, projects are underway to design "free hardware" where the complete design is documented and available to all. These boards and systems, which we expect will be built and sold by existing hardware vendors, will serve as a flexible open platform for free software radio development.

For example:

### GNU Radio

GNU Radio is a free software toolkit for learning about, building and deploying software radios. Being free software, it comes with complete source code so anyone can look and see how the system is built. In addition to support for broadcast and narrow band FM radios, GNU Radio has a complete implementation of an ATSC digital HDTV transmitter and receiver.

Websites for further reference:

http://www.sdrforum.org/pages/aboutSdrTech/about SdrTech.asp

http://en.wikipedia.org/wiki/Software-defined_radio

http://digilander.libero.it/i2phd/winrad/

Http://www.arrl.org/tis/info/sdr.html

**Software Defined Radio or SDR** is hot topic for discussion in amateur circle. Being hailed as future of radio and communication we became curious and started experimenting with whatever little resources available at our end. I was amazed at what could be done, imagine just one small box of hardware and you have with you practically all available brands and models of transceiver on your PC. It was time to homebrew one.

As usual I needed a push and this came from VU2IIT , HAM club IIT Kanpur ,during my visit in 2005 for Takneek, their college techfest. Feb 2006 was slated for Techkriti, nation wide mega inter college techfest.

We decided to have something ready by then.

Back home at Lucknow I tried couple of designs in conjunction with available software's unfortunately I could not reach any conclusion as my PC was quite slow. Measurement on my scope indicated that I was getting signals right.

Anyway I did attend the fest in Feb-06 along with a small box hidden in my bag. Schedule was quite hectic and only a day prior to my departure I had any chance to look upon that box. Late at night along with budding amateurs and engineers we said lets give it a try. Software's were loaded , frequencies set , PC up and running we powered it up, there was silence for a moment but as we were going thru with configurations shack was filled with Oh! that static and far off voices. Congratulations! VUSDR was operational. Media came next to have a look and things moved on.

This year Jan I again visited IIT Kanpur but was surprised when I was told radio workshop was now a main event in college festival and not restricted to HAM club alone, I was requested to conduct a nationwide workshop on SDR technology. I was left speechless. Given the honor I went along with a simplistic design based upon sampler experiments of YU1LM OM Tasa.

## Principal Operation:

Hardware is based on Sample Hold (S/H) technique a demodulation scheme suggested by DJ2LR Dr Ulrich Rhode and later experimented and worked upon by YU1LM. Basic design can be considered as 2 channel or dual direct conversion receiver with same local oscillator (Love,) phase shifted by 90 degrees. Wide band phase shift is achieved by pushing the LO thru a divide by 4 counter this puts the requirement on LO of 4 times higher than the received frequency.

Signals are applied to analog switches that are switched in accordance with the 90 deg phase shifted LO signals. Output is sampled thru a resistor and capacitor combination acting as Sample Hold detector. Resulting demodulated voltages are summed up in a dual op amp and resulting I Q signals are BW limited and sent to PC soundcard for further processing.

## Circuitry:

Local oscillator is based on 2 nos Bipolar device oscillator running from 13MHz to beyond 60Mhz enabling a coverage from 80mtrs to beyond 20mtrs. The LO runs 4 times the received frequency covering 12-50mhz + giving an effective coverage from approx 3mhz to 15mhz. 10pf coupling cap at base of Q1 may have to be slightly increased in some cases. Supply to LO is regulated by 6V8 zener and tuning carried out by a common FM radio PVC gang capacitor, both sections paralled.

Coil is air core 9 turns of 22 swg enameled copper wire wound on 8mm drill shank. It is tapped at 3 turns from ground end.

Lo signal clocks the counters in IC2 74HC74 and we get a divide by 4 output at four different phase of 0,90,180 & 270deg. 0 and 90 deg signals are applied to the MUX/DMUX chip via 100 ohm resistors.

Signal from antenna is applied direct to input of 74HC4053 IC1 a MUX/DEMUX chip that is switched in accordance with the local oscillator signals. These chips can work well beyond 30MHz in these applications. Board has provision for simple Low Pass Filter (LPF) but while running broadband they are left out of circuit and a jumper directly applies signal to input of sampler chip. This compromise alone indicates high level of performance of this generation of receivers and their immunity to overloading. 33ohm resistor and 47nF cap at the output of chip forms the SH detector element. Resulting detected baseband signal for to different LO phase is summed up in two dual OP amps.

22K resistors around OP amp control the gain of stage if more is needed they can be increased to 47K. 10K multi turn preset along with 18K resistor forms a gain control of one channel this helps in balancing both the channels which ultimately leads to good suppression of image response. Bandwidth is limited by four 220pf capacitors. Outputs I & Q are applied to soundcard line in input.

## Assembly & Commissioning

Assembly is quite straight forward start with lowest profile component ie place all jumpers. Take care to put 2 jumpers below IC2 first. Place IC socket so that you have some bearings on board. Install resistors and 7805 regulator. Do not put in any chip in their sockets. Adjudt the trimpot to get 18K resistor and trimpot combo to get 22K.

Wind VFO coil and connect gang capacitor. Inspect the board. Apply power Check 5V at out put of regulator and 6V8 at the VFO zener. Check 5V at pin 3 &5 of IC3 and 2.5V at 4 and 15 of IC 1. Disconnect power and insert IC2 power up and measure 2.5V on each of the LO signal ie on pin 9.10 of IC1. This indicates that a 50% duty cycle signal is present on each of the pin.

Install rest of the ICs and and connect a pair of stereo PC speakers on output ie I&Q channel. Tune if all well a cacophony of stations will be heard with a decent antenna.

Using a stereo EP to EP lead connect SDR to Line In of PC. Mic in will not function as it is mono where as we require a stereo connection for image rejection. Install either of the following softwares:

1) M0KGKSDR
2) ROCKY
3) WINRAD
4) SOFT ROCK
5) POWER SDR

Go thru various notes on respective website and do set up. Rocky is probably easiest and low on resources. Select soundcards , please note for M0KGKSDR you require ASIO4ALL driver from net.

Unmute channels from mixer box and Volume control. Get the program running tune around you should be able to see spectrum upon screen click any station, select demodulation mode and bandwidth and enjoy.
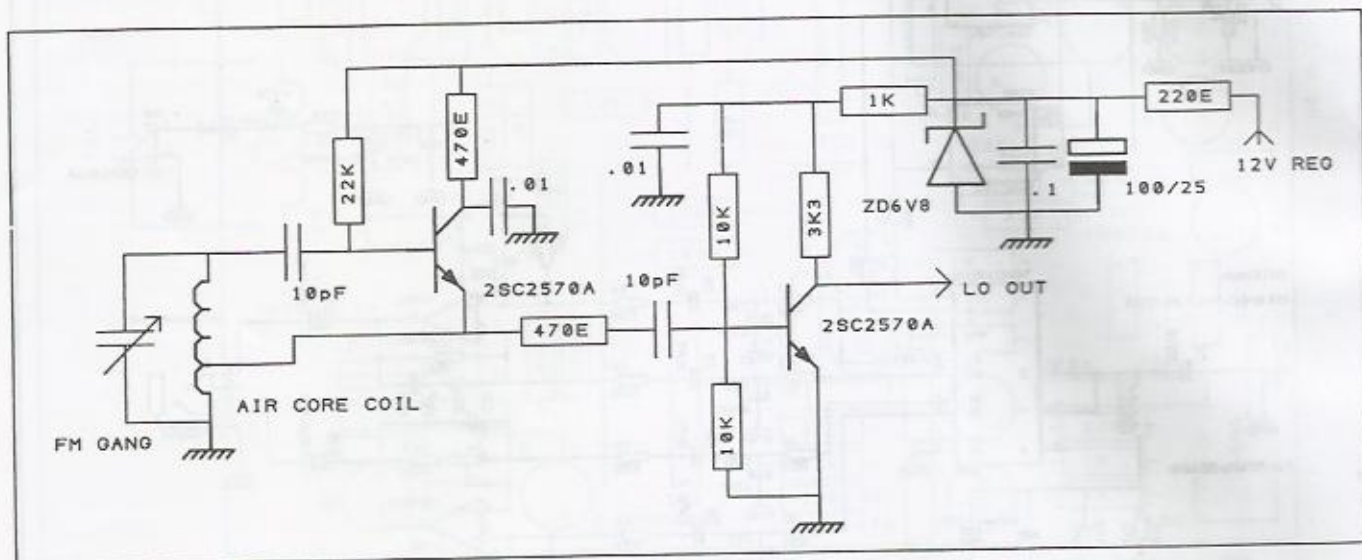
## Note & FAQ:

No reception : Check LO and connections

No Image rejection: Both I & Q Channels not available

HUM: Unfiltered supply use a good quality regulated 12V supply Large peak in centre of spectrum: Normal it is the DC offset of your soundcard. Whistling sound : Mute Line in in Volme panel so the signal does not passes direct to phones.

IC4
7805

+12V I Q Sh

Q1
10n
Q2 220p

Cp

4007

10p
22K
470E
1K
10K
10K

33E

VC1
470E
220E
1K
22K
10K
Cp

10n
10p

ZD 6V2
IC2
74HC74
220p

L1
100E
100E
IC3
NE5532
100E
22K
100E

47n
1K
22K
1K
220p

Techkriti 07

Cp

33E
47n
2u2
2u2
18K

J X
X
1K
100uH
47n
2u2
33E
220p 220p

ANT
X
33E
22K

1K
33E
1K

C Cp
1K
IC1
74HC4053
33E
2u2
1K

47n
10K
VR1

L1= 9turns 22SWG tap 3 turn
above Gnd 8mm dia air core
or on tap washer torroid

Cap marked C= 100nF
Cap marked Cp= 100uF/25V
Component marked X not used

Q1, Q2 2SC2570A

**VUSDR** Software Defined Radio · **VU3WJM Rahul**

62.86mm

99.06mm

Techkriti 07

# QUIZ

18Ω
30Ω
36V
8Ω (M)
18Ω
6Ω

(b)

The figure shows an unbalanced Wheatstone
bridge. The detector is represented by the
circle M (a null symbol) in series with 8'Ω, this
meter's terminal resistance.
What current flows through the detector?

*From BREAK-IN magazine (March-April 2007)*

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custom audio and data modes, and easily modifiable parameters. In addition as new techniques are discovered and implemented, it is possible to make these available to users of an SDR simply be downloading software, and without any need to change the hardware.



This is the exciting new world that is now opening up to radio amateurs

## SDR Technology : A Glance
Amateur radio in past has seen convergence of lot of technology from simple spark gap transmitters to space based communication. SDR is an example of one such development, it is convergence of radio communication and DSP ( Digital Signal Processing).
One would wonder what is so great about a Radio on PC when TV tuner and other cards have been available for long ,answer lies in differeciating between a PC controlled system and a PC being a system. In SDR the functionality is defined within the software ie to change the nature of equipment all that is required is just a change of software.
Until recently SDR was only an expensive R&D exercise with main interest being in military sector. JTRS (Joint Tactical Radio System) a $25 billion development exercise. Lately there has been a flurry of activity and many companies and products have been launched into the market.
SDR's definition is disarmingly simple: "In a software-defined radio, functions that were formerly carried out solely in hardware, such as the generation of the transmitted signal and the tuning and detection of the received radio signal, are performed by software that controls high-speed signal processors."
HAMs were quite impressed when DSP ( Digital Signal Processing) was introduced into their gear, reception became clear and brick filters implemented had simply stunning performance. SDR relies deeply on DSP technology to function.
For amateur radio purpose we can broadly categorize

SDR equipment into two types

1)      Stand alone system
2)      PC Based
Former has the main software and hardware ie ADCs in the equipment itself while latter relies on soundcard and PC for processing.

The ultimate SDR would be an antenna plugged directly into a very high speed analog to digital converter and using a computer to do the rest of the processing. Such plans are still not possible, but by careful use of existing RF techniques, it is possible to produce radios that use DSP techniques on normal PCs, while benefiting from good RF design techniques.
Why?? DSP, well DSP provides the possibility to have very high quality filters that do not suffer from "ringing", custom audio and data modes, and easily modifiable parameters. In addition as new techniques are discovered and implemented, it is possible to make these available to users of an SDR simply be downloading software, and without any need to change the hardware.
This is the exciting new world that is now opening up to radio amateurs
Let us see how it is done: If we take a look at sine wave on scope we will observe a very smooth curve varying with time. Digitally we can consider this as infinite number of voltage steps over time. If we measure these analog voltages at precise times we get a digital representation of input sample voltage.

In 933 Harry Nyquist discovered that in order to recover all components of a periodic waveform it is necessary to

use a sampling frequency at least twice the bandwidth of the signal being measured. As an example let us consider an audio CD with max signal of 20khz, world standard follows a sampling rate of 44.1 khz just a bit more than twice the bandwidth. Let us see how a PC soundcard based SDR works.

In this application we have a limited bandwidth that can be digitized by a PC soundcard . All common cards can sample at 48Khz however there are other expensive cards that can sample at 96 or even 192Khz. Hence this the bandwidth that can covered at a time. Since this is very low than our operating frequency we need some hardware to down convert our bands to this range.

To make it simple to understand this hardware can be looked upon as a direct conversion receiver with very wide bandwidth. Conversion can be done using any of the standard mixing technique like diode ie passive or active mixer, sample hold detectors, quadrature sampling detectors QSD etc. Lately QSD detectors by Dan Tyloe N7VE a Motorola engineer using FST bus switches and Sample Hold detectors designs by Dr Ulrich Rhode DJ2LR and Tasa YU1LM based on cmos switches have become very popular due to their large signal handling performance and dynamic range.

In a downconvertor the signal is applied to 2 detectors simultaneously these detectors are fed with same LO phase shifted by 90 degrees as shown in diagram below:
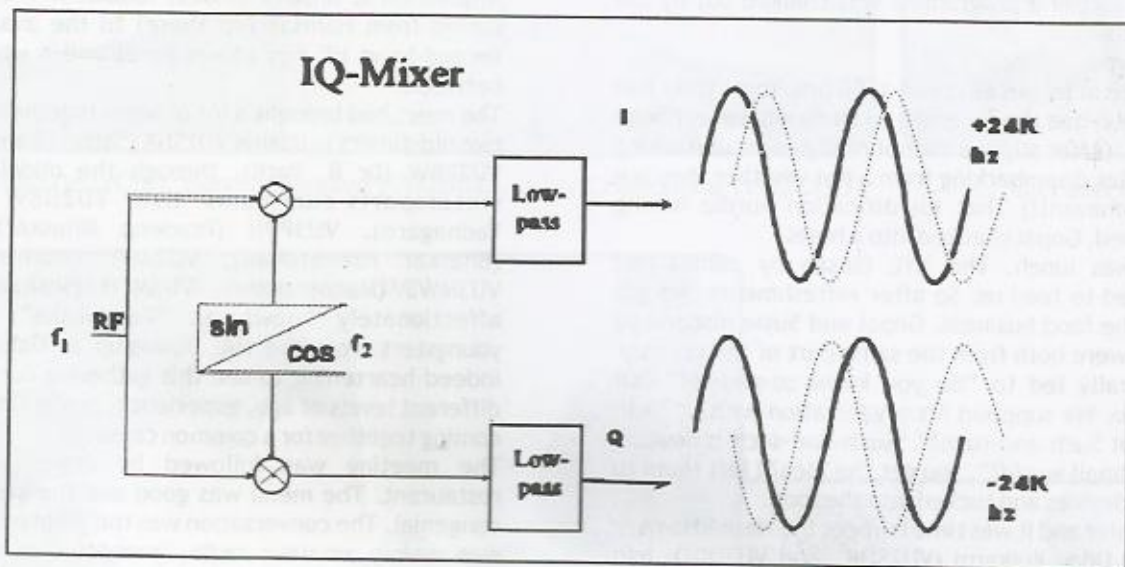


Phase shifting of LO can be done by various methods like RC network, LC qudrature hybrid , flip flops clocked at 4F etc. LC hybrid and RC network are frequency dependence and have phase errors as we deviate from calculated frequency on the other hand using a flip flop and division by 4 we have a broadband 90 degree phase shifting. Some DDS chips provide direct phase shifted output. Simple Xtal oscillators and other PLL solutions can be also used for VFO.

Output result of this mixing is a complex signal generally called I In quadrature and Q Quadrature signal. Since these are relatively low frequency signals they can be easily amplified in low noise op amps and are given to left and right line input of PC soundcard.

For good image suppression care should be taken that levels in both channels are balanced. It should be further noted that we need to process 2 nos channel hence a stereo line in is must , Mic input is mono hence it will not give any image suppression in this type of application. Soundcard is the heart of the system.

Software's running on PC in conjunction with soundcard provide rest of the filtering and demodulation and other functions.

Notable software's:

Rocky : Written by Alex VE3NEA this is very simple receive as well as transmit software using 2 soundcards. Software is regularly being updated. It can demodulate PSK signals also apart from SSB and CW modes.

Soft Radio & Winrad: Written by I2PHD Alberto, these are very powerful software that can be used with any IQ receiver. Winrad is a true engineers delight program with interface being based on Linrad the Linux SDR software. This software is being extensively used for weak signal work.

Power SDR: Released by Flex Radio is the official software for their SDR1000 transceiver. KD5TFD version of software is modified to give full functionality with very simple hardware.

M0KGK SDR: One of my favorite this is complete transceiver software with PSK and all and works extremely well.

There are many other software's and few by Our VU Hams as well, Farhan designer of famed BITX20 has a DSP shell on his site . VU3RDD Ramakrishnan has made available a GNU radio module.

Some current worldwide SDR projects are Softrock40 and its various versions, Firefly SDR, NC2030 transceiver, SDRZero etc.

Some commercial solutions are SDR1000 from Flex Radios and RF Space SDR14.

With our given strong software infrastructure time is ripe for VUs to take plunge into the future of communication.

........................................................

# A DAY WITH VU2 GMN

## By VU2CVD, ANIL REGE

Once upon a time ...... (OK this is not a fairy-tale, so let's get down to brass-tacks)

When VU2GMN (a.k.a. Gopal Madhavan) mentioned that he was to be in Pune on Sunday 27th May, and that he was free to come to Nasik the next day, I thought it was a good idea. For one very good reason. Amateur Radio activity in Nasik is at a pretty low level and I figured that Gopal's visit was essential to push up the level.

A flurry of phone-calls, emails and a meeting or two later and some sort of a programme was chalked out by the NashikHams.

D-Day arrived.

Gopal came in by bus at about 1100 hrs. Yours truly had (fortunately) had the foresight to study whatever pix he could find. (After all, one cannot really go around asking all the males disembarking from a bus whether they are Gopal Madhavan!!) That identification hurdle having been crossed, Gopal checked into a hotel.

Then it was lunch. The XYL (Susan by name) had volunteered to feed us. So after refreshments, we got down to the food business. Gopal and Susie discovered that they were both from the same part of the country. This naturally led to "do you know so-and-so?" "Of course I do. We supplied his organization with..." "And what about Such-and-such?" "Such-and-such is now... " "Isn't it a small world?". You get the idea? I left them to their own devices and tucked into the food.

A snooze later and it was time to meet the NashikHams. Smita and Uday Kulkarni (VU2SQK and VU2UGQ) had bravely volunteered to let us use a hall in their office premises for the get-together. (They have also rashly allowed us to use the premises as club premises when we get around to forming a club. Thanx you two!! )

Since the time was supposed to be 6:30 p.m., we naturally started after 7 p.m. After a brief round of introductions, Gopal shared his thoughts with us.

(As a background quite a few of the licence-holders in Nashik are motorsports enthusiasts.)

Gopal's talk showed a seamless reconciliation between motorsports and amateur radio. It started with his activity in the Himalayan rally when he was NOT allowed to transmit as he wasn't a ham. His talk also touched on the dangers to ham frequencies, the dangers of broadband over power lines, and the need to come together in large numbers to protect the interests of amateur radio country-wide.

A question & answer session followed. The questions varied from Hamsat (up there) to the availability of second-hand HF rigs (down here) and a whole lot in-between.

The meet had brought a lot of hams together. From the two old-timers in Nashik VU2SNK (Satish Chandorkar)and VU2PBW (Dr B. Patil), through the middle i.e. the motorsports-cum-hams like VU2DBW ("Nana" Vadnagare), VU3PPN (Pradeep Mhaskar), VU2CIG (Bhaskar Patwardhan), VU2AWE (Ashwin Pandit), VU3MWJ (Manoj Joshi), VU3MTH (Shrirang Machhe affectionately known as "Pandukaka") to three youngsters from the HAL Township at Ozhar. It was indeed heartening to see this gathering cutting across different levels of age, experience, professions etc, and coming together for a common cause.

The meeting was followed by dinner in a local restaurant. The menu was good and the company was congenial. The conversation was the greatest because it was mainly amateur radio, anecdotes of motorsport events, and a whole lot of jokes interspersed with a lot of laughter. The dessert was matka-kulfi. Last seen, some of the OMs were getting their kulfis blessed by an Old Monk.

All said and done, it was an eventful happening. Just the stuff needed to kick-start ham activities in Nashik.

Gopal left the next day- heading for a meet with the ThaneHams. Hopefully that story will also be on these pages ...........................................................

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## LETTER TO THE EDITOR

Lately while monitoring the bands I hear that some VU hams tell their DX counterpart that in India we do not have a QSL Bureau or we do not get cards from the bureau, please QSL direct. I have made search and found out that they are either non member of ARSI or not deposited token amount with the bureau to show their interest to get their DX QSL Cards. Hence, I request all hams to enquire if they have fulfilled above two criteria or not otherwise they have no right to degrade the image of amateur of India. Object to such QSOs. Again I humbly remind all concerned that please adhere to the above two criteria and get your QSL Cards from the bureau. For any assistance email me vu2dpd@yahoo.com you will be given reply. 73,DIPU,VU2DPD.

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## Silent Key

OM Ramkee, VU3ROX, passed away on 5th May 07, due to cardiac arrest. He was 32 years old, a medical representative. He was very active on vhf on the Kodai repeater and a very ardent shortwave listener and had received many good receivers as gifts from Dx clubs abroad. He is survived by his wife and a five year old son

VU2 NMI , (OM Dr. N. C. Goyal) became a silent key at Gwalior on 26th April 2007. He was 66 yrs old and was instrumental in setting VU2 MIT club station at Madhav Institute of Sciences Gwalior, where he worked as a Professor and Head of Department in Electronics for many years. He popularised Ham activity in and around Gwalior.

Dr. N.Tata Rao ,VU2NTR, passed away on 7th April 2007.He was well known for his special interests in HF DXing and was an active Ham for over two decades. He served for over 14 years as Chairman, Andhra Pradesh State Electricity Board. He was also Governing Council Member of National Institute of Amateur Radio.

VU2AK Les (Chief) passed away on 6th March 2007 of a massive heart attack. He was 87. He and Audrey VU2YL celebrated their 64th anniversary recently.

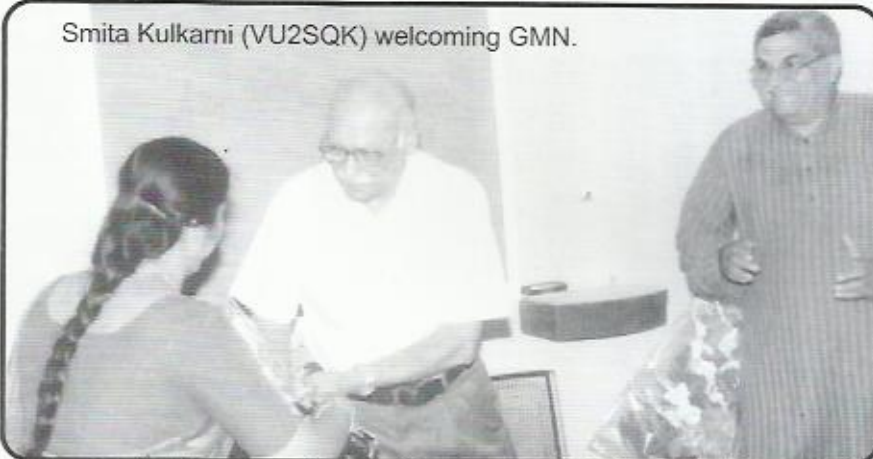# A DAY WITH VU2 TO GMN AT NASIK

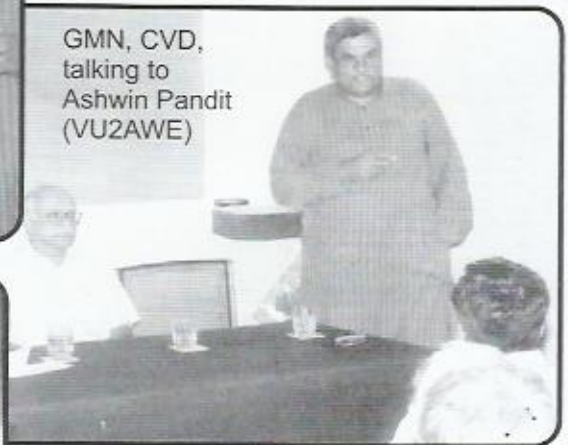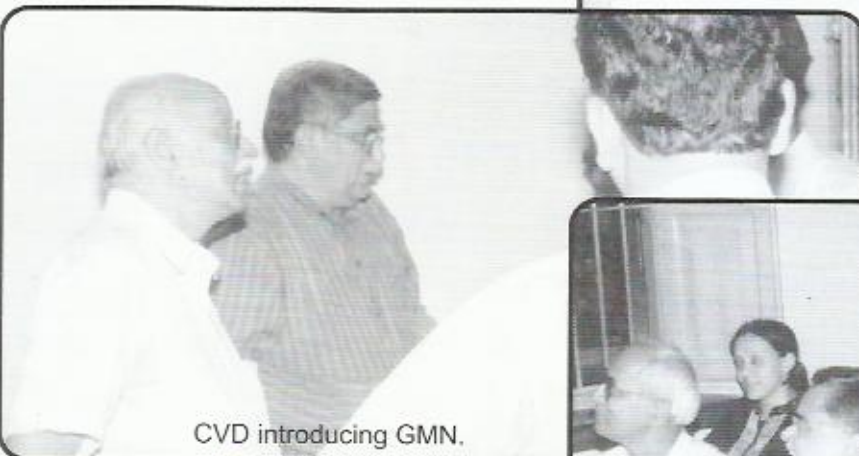Manish Chitko (VU2CIE), Sandip Randive (VU2BGL), Uday Chandorkar (VU3CUO)

CIG and MTH

Smita Kulkarni (VU2SQK) welcoming GMN.

GMN, CVD, talking to Ashwin Pandit (VU2AWE)

CVD introducing GMN.

MTH, DBW, three enthusiasts from HAL Township at Ozar 20 kms away, Satish Kulkarni (VU3SPY), and a part of BGL

# SDR TECHNOLOGY WORKSHOP AT IIT KANPUR

OPENING LECTURE

SRIRAM CO-ORDINATOR IIT

ARUNABH CO-ORDINATOR IIT

## FOX HUNT AT IIT KANPUR

## VU2WJM DEMONSTRATING SDR

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