IEEE DySPAN 2008 Demonstration Track
Call for Proposals

Introduction

IEEE DySPAN 2008 will provide the opportunity to conduct live demonstrations of dynamic spectrum systems and networks. This year's event will build on the huge success of the demonstrations at IEEE DySPAN 2007 by offering an invaluable opportunity to **demonstrate, experiment, and interact** with other world-leading researchers. This is a call for proposals to demonstrate systems, prototypes, and critical technology components and algorithms at IEEE DySPAN 2008.

IEEE DySPAN 2008 will be held in the Millennium Knickerbocker Hotel, Chicago, IL from Oct. 14 – 17th 2008. Further information regarding the symposium is available at http://www.ieee-dyspan.org/2008/

In addition to pre-planned demonstrations, unique opportunities may exist for experimentation by participants. Such opportunities include general measurements of spectral activity during the demonstration and experimentation sessions; the interaction of various, independently-developed systems and networks; and the coexistence of systems using different spectrum adaptation algorithms.

To participate in the demonstration and experimentation activities, candidates must complete the attached form to provide a description of the proposed demonstration and/or experimentation. The proposals will be evaluated by the DySPAN demonstration committee based on the following criteria:

- **Technical Significance**: the extent to which the demonstration illustrates advances in dynamic spectrum access technologies.

- **Demonstration Maturity**: the demonstration must be mature enough "to leave the lab." Demonstrations involving RF transmissions must include *a priori* or *in situ* risk mitigation measures to ensure regulatory compliance and coexistence with other spectrum users.

- **Demonstration Supportability**: the demonstration must be performed within the capabilities and resources of the DySPAN symposium. Demonstration systems should ideally coexist with other potential demonstrations on a coordinated or uncoordinated basis.

The selected demonstrations will undergo a final review approximately 45 days prior to the symposium to ensure their operational readiness.

Accepted proposals are encouraged to submit a two to four page demonstration description to be included in the DySPAN 2008 proceedings.

Important Dates

February 29, 2008	Complete attached proposal form and submit to dyspandemos@ctvr.ie
April 1, 2008	Notification of demonstration proposal acceptance
September 1, 2008	Submission deadline for demonstration paper
October 14-17, 2008	DySPAN symposium

Regulations and transportation

Regulatory licenses will be negotiated and procured by the demonstration committee based on submitted system capabilities. It is therefore necessary to have knowledge of all possible frequency ranges a device is capable of using if certain frequencies are restricted for experimental use in Chicago.

It is the responsibility of each demonstration participant to secure shipping and handling of their equipment to and from the demonstration site. Those companies/research institutions that will ship equipment from outside of the US may wish to arrange a Carnet. The Carnet is a type of “Merchandise Passport” that can be used as proof that you are temporarily importing commercial samples or professional equipment for exhibition in the host country. US Customs and Border Security is part of the Carnet program as are many other countries. Demonstrators from countries that do not participate in this program will need to contact their local customs officials to facilitate transportation. A suitable link to learn more about Carnets is: http://www.uscib.org/index.asp?documentID=718

Other points of note:

- Moving large amounts of electronics through an airport (especially customs) is going to take time. Consider using airfreight for transferring equipment. Otherwise, prepare well in advance and be sure to have all supporting documentation on hand.
- It is also advised that participants consider insurance for any hardware during the symposium and shipping process.
- To obtain a shipping address for the symposium, send a request to dyspandemos@ctvr.ie

Contact Information

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www.ieee-dyspan.org/2008/

DySPAN 2008 Demonstration Proposal

Complete the following form with as much detail as possible. This information will be used to evaluate suitability of admission into the DySPAN Demonstration Session based on the technical significance to the symposium, demonstration maturity, and demonstration supportability.

Contact Information

Primary Contact Name	Peiman Amini
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Abstract

Provide a concise (300 words) summary of the proposed demonstration and its technical significance.

In disaster situations, it is crucial for first responders to have the ability to communicate quickly and reliably. Given the relative scarcity of available spectrum, coupled with the amount of required spectrum to approve new users, the issue of spectrum access is the hardest task in the development of wireless networks geared towards first responders. Cognitive radio technology is the natural choice to overcome this access problem. First responders can use the idle portions of the spectrum to communicate with each other. In our demonstration, the Family Radio Service band is chosen to implement a cognitive network of nodes able to transmit voice. The cognitive radio modem is implemented on the Lyrtech Software Defined Radio Platform. Our embedded solution is implemented on FPGA and DSP, while the correct choice for implementation of each block is made to optimize for limited resources on the hardware. In the demonstration, using an arbitrary signal generator, the interference of primary users (PUs) over 5 MHz of bandwidth is emulated. We are able to show that our cognitive node can move to an unoccupied frequency band when a PU starts transmitting on the carrier that is currently in use. In our presentation, we transmit voice between two SFF SDRs to show that our cognition works. The method used for sensing should feature a high spectral dynamic range to enable the detection of the low power users. We choose the filterbanks sensing method. Filterbanks perform better than FFT in terms of detecting low power users when users with high power and low power are present. The sensing is done in each node inside the network and the results are passed to a base station which combines all the sensing information to compile channel state information.

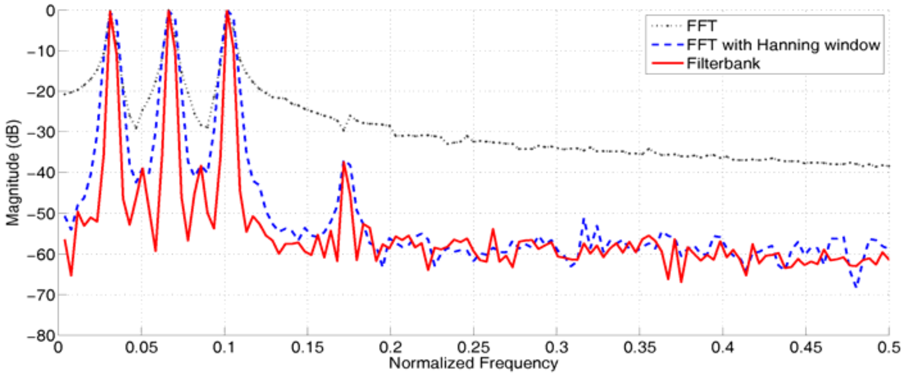
Description

The description should include sufficient detail such that the evaluators can understand the purpose, configuration, design, and conduct of the demonstration/experiment.

Primary technical goals

There are two primary goal that we had in our project:

1) For reliable detection of spectrum holes, the channel sensing mechanism needs to feature a high spectral dynamic range. Unfortunately, the FFT based methods are not able to fulfill this requirement. As a consequence, we decided to use filterbanks for sensing. 2048 samples are used for the filterbank with prototype filter of length 2048. The results of FFT, FFT with a Hanning window and filterbank are averaged over three decimated sample. The calculated PSD from 462MHz to 467MHz for these three methods are depicted in Fig. 5. As we can see filterbank sensing is able to show all the transmitted sinewaves clearly. FFT, on the other hand, has a considerable spectrum leakage which results in missing the three sinewaves at 463.367MHz, 463.545, and 463.985MHz. FFT with hanning while having better dynamic range than FFT, also misses two of the sinwaves



2) We have an embedded solution which runs on DSP and FPGA. Therefore, we can test our cognition algorithms on real time basis. As a result, we can switch to the free bands with minimal interruption in the flow of voice traffic.

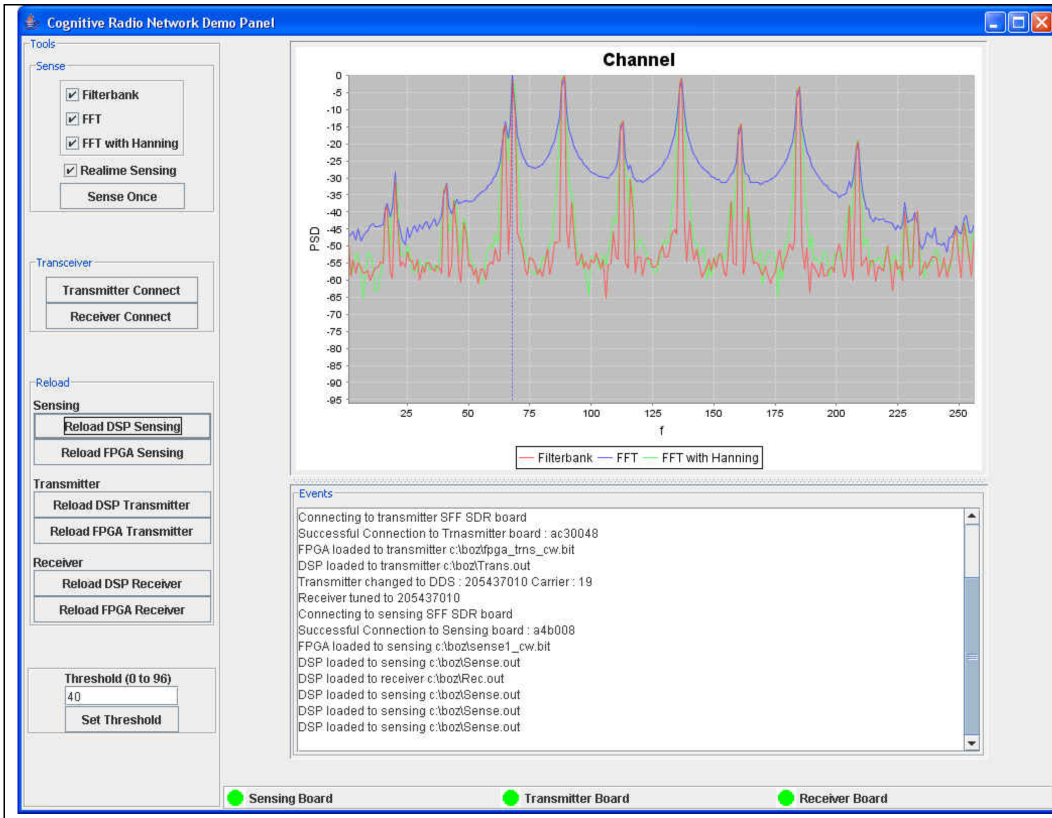
3) We have used Hardware in the loop (HIL) technique to develop our testbed. The HIL technique which incorporates DEVSJava package in Java, MATLAB, and the SFF SDR hardware platform, will be presented in our demo.

4) We assume a dedicated control channel for our system. This (now wired) channel should be leased and therefore our radio is a PU over the control channel.

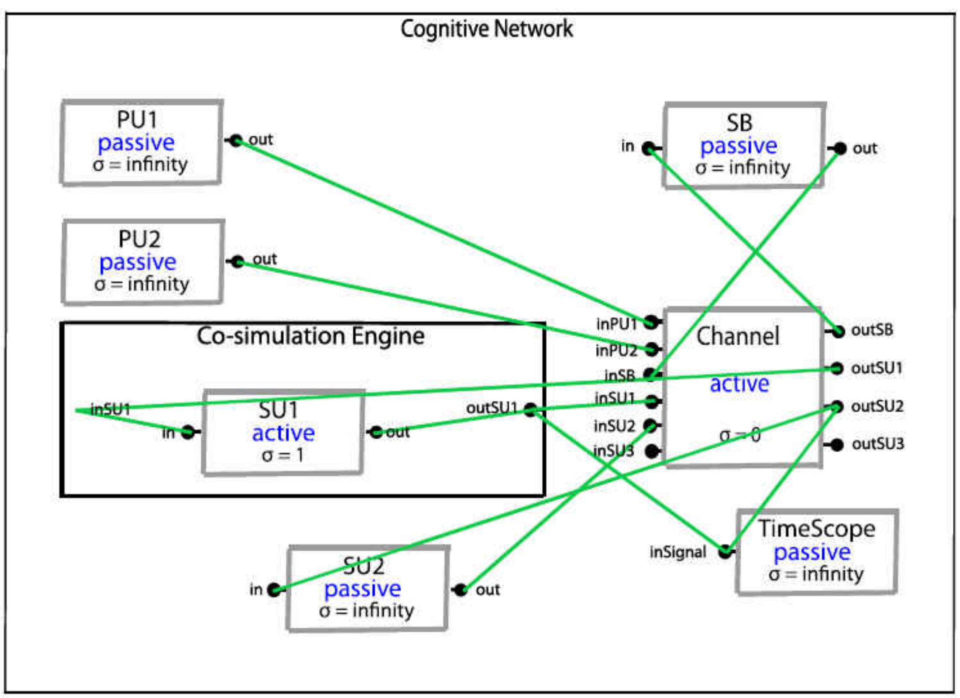
Description
Pictures, screen shots, and system drawings are encouraged (attach as necessary)

In our presentation, we use Java to simulate the activities of primary users (PUs). The combination of MATLAB and Java is then used to combine the simulated signal of the PUs. The signal is then loaded to a Vector Signal Generator. We are able to show that our cognitive node can move to an unoccupied frequency band when a primary user starts transmitting on the carrier that is currently in use. In our presentation, we transmit voice between two SFF SDRs to show that our cognition works.

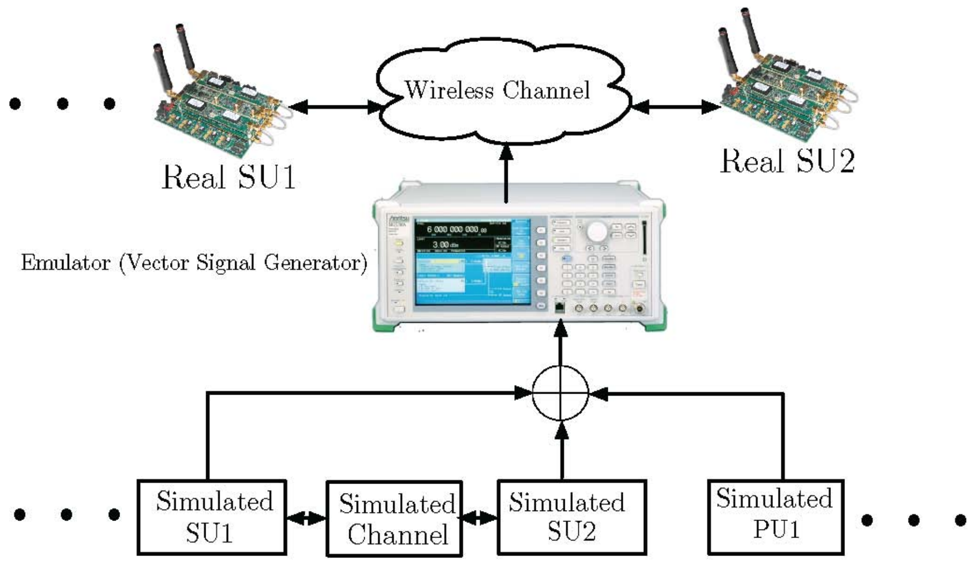
The following figure is the developed panel in Java for connecting to the boards and presenting the sensing results and log of the events in the system. The filterbank-based sensing result, FFT and FFT with hanning are also illustrated in order to show the activities in the spectrum.



The following figure is the HIL simulation of Cognitive Radio in DEVSJava. In this figure only one SU has real hardware (SU1) while everything else is simulated. The simulated PU and simulated PU are emulated on the channel to test our sensing method in the real SU. This technique let us proceed in the implementation phase while we were waiting for more hardware. Applying the progressive simulation-based design the complexity of system was also reduced.



Next figure shows the Progressive simulation based design of a cognitive radio network. In this figure 2 real secondary users detect the presence of emulated primary and secondary users on real wireless channel. A vector signal generator is used to emulate the traffic of simulated users.



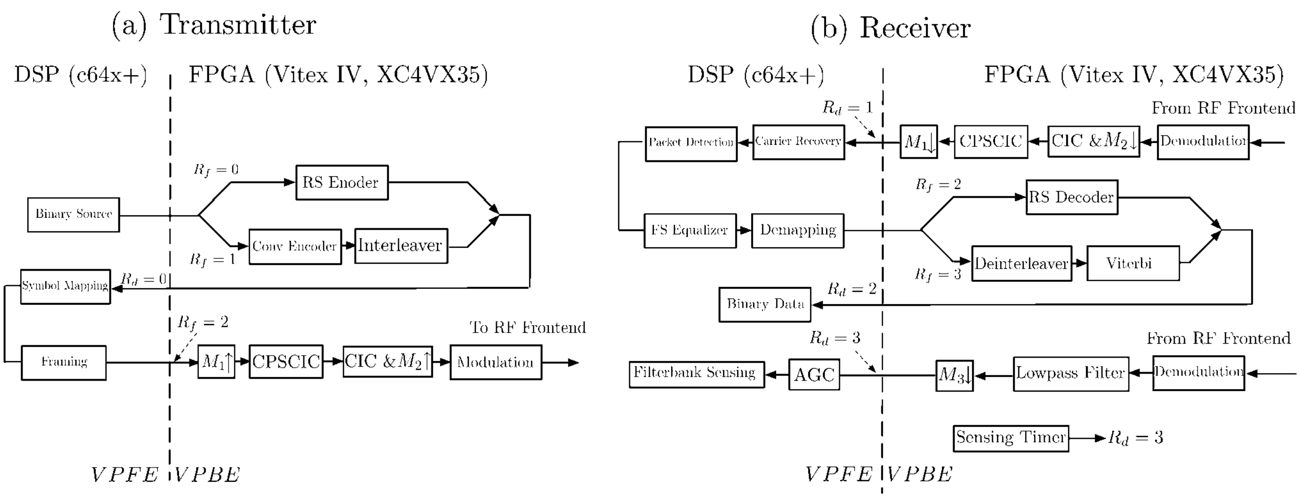
Operational parameters	
Frequency Ranges	462-472 MHz
Bandwidth	25kHz for each carrier
Peak Input Power to Antenna	-5dbm.
Antenna polarization and gain	Dipole antenna.
Waveforms (modulation type)	FM

Technical Significance

Address the technical significance of the demonstration/experiment.

Description of the technologies

We have used the SFF SDR to develop an embedded solution for the spectrum access for first responders. As it was mentioned in the Primary Technical Goal, our sensing methodology, HIL technique, and embedded solution on DSP and FPGA is the significant points of our demo. The distribution of the SDR modem components between the DSP core and the FPGA is shown in the following diagram. The Video Processing Front End (VPFE) and a Video Processing Back End (VPBE) ports are used to transfer the data streams back and forth between the two modules while the custom registers in the FPGA are used for handshaking.



A discussion of the perceived impact of the demonstration to dynamic spectrum in general and the DySPAN audience in particular

Our demonstration presents a novel spectrum sensing method which can detect low power users while there high power users on the channel. Our measurement results show that filterbank sensing method has less spectrum leakage than FFT, as predicted in our earlier simulations and publications.
Furthermore, we present a development methodology based on the progressive simulation based design and development; we start from simulation and substitute the models with real modules step by step to build a full functional modem. Afterwards, to develop the network of the cognitive radio modems, we deploy the available real modems. Using this method, one is able to develop our cognitive network while we do not have enough hardware.

Technical Maturity and Operational Capabilities

Provide sufficient detail regarding the maturity of the demonstration/experimentation.

Current state of the technology, hardware, and software

Our hardware and software implementation is complete and ready for presentation.

Amount and type of work yet to be done prior to DySPAN

Our system is ready for the demonstration.

Risk mitigation methods to be implemented to ensure proper operation within regulatory constraints

We perform spectrum sensing 10 times a second. The whole band is sensed at every sensing interval and our spectrum sensing method features a high spectral dynamic range. Therefore, we are able to detect the presence of PUs or other SUs and avoid interfering with them.

Previous experience and trials of demonstration equipment's coexistence with other communication systems

Note that a summary of existing test results may be useful in conveying the operational readiness and stability of the demonstration/experiment

The test bed was presented in the 2007 Software Defined Radio Technical Conference and Exhibitions as part of the Smart Radio Challenge. We were able to show that we can coexist with other active PUs and SUs on the FRS band during the two days of exhibition.

Logistical Needs

Include the logistical needs for supporting the demonstration/experiment at DySPAN. These details allow the planners to properly acquire and allocate resources to support the demonstrations.

Amount of space required (sq. ft or sq. m)	6
Number of demonstration tables required	2
Input power requirements and number of outlets (note: US uses 120V, 60 Hz power with a NEMA 5 (flat 3-prong) plug)	5 outlets (120V)
Approximate power consumption	1000 W
Storage and security requirements for equipment	Small storage required
Instrumentation and other support equipment requested of DySPAN	We need a spectrum analyser and a vector signal generator.
Internet/network access (wireless, wired, number of ports, etc.)	N/A
Other needs	N/A

Checklist

[X] Contact information is complete and accurate
[X] Abstract
[X] Description is complete, including all operation parameters requested
[X] Technical specification
[X] Technical maturity and operational capabilities
[X] Logistical needs described as fully as possible
[X] We grant permission to make the information in this proposal public.