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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Phone: +353 1-8968443

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	Paul Sutton, Emerging Networks, CTVR, Lloyd Building, University
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Abstract

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

A Dynamic Spectrum Access Network Using Cyclostationary Signatures for Network Formation, Network Rendezvous and Link Maintenance.

Dynamic spectrum access networks (DySPANs) achieve very high levels of spectrum use efficiency by detecting spectrum *white spaces* and temporarily exploiting them to create communication links. In order to use idle spectrum resources in this way, DySPANs are capable of reconfiguring key operating parameters during the course of operation while robustly maintaining communication links. Key among these operating parameters are the operating frequencies and signal bandwidths used. By adjusting operating frequencies, DySPANs can transmit and receive using temporarily idle, white space spectrum. By adjusting signal bandwidth, transmissions can be tailored to the properties of the detected white spaces and maximum spectrum use efficiency can be achieved.

While the dynamic reconfiguration of operating parameters permits DySPAN systems to adapt to spectrum use conditions, the lack of a priori knowledge regarding these parameters can pose significant challenges for network formation, network rendezvous and link maintenance. Cyclostationary signatures are intentionally embedded cyclic features which can be generated in data-carrying multi-carrier waveforms and used to overcome the challenges associated with DySPAN rendezvous, coordination and link maintenance. By employing waveforms containing cyclostationary signatures, DySPAN devices can dynamically adjust the carrier frequencies and signal bandwidths used to suit operating conditions while maintaining communication links and facilitating network formation and network rendezvous by new devices.

The demonstration involves one or more networks of DySPAN devices implemented using the CTVR reconfigurable software radio platform. These devices dynamically coordinate to establish network links and communicate using detected white space spectrum. Embedded cyclostationary signatures are used to enable dynamic reconfiguration of operating frequencies and signal bandwidths. These signatures permit receiving devices to perform waveform recognition and successful demodulation of detected signals.

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

To illustrate the use of embedded cyclostationary signatures to achieve network formation, network rendezvous and link maintenance while permitting the dynamic reconfiguration of operating frequencies and bandwidths. These goals are achieved without the use of a control channel and without the requirement for a fixed channelization scheme.

Description

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

A cyclostationary signature comprises a correlation pattern in the spectrum of a transmitted waveform which can be detected and analyzed with limited prior knowledge of the operating parameters used within that waveform. In a multi-carrier system, such a spectrum correlation pattern can be embedded using the process of subcarrier mapping. Fig.1 (attached) illustrates subcarrier mapping in the generation of a multi-carrier waveform. Fig.2 illustrates the cyclic spectrum of the resulting waveform, with the embedded cyclostationary signature highlighted. A network is created between 3 or more devices using dynamic OFDM-based waveforms containing embedded signatures. These signatures permit the challenges of DySPAN network formation, rendezvous and link maintenance to be overcome.

Operational parameters

Frequency Ranges	Can operate in ranges between 2.3 and 2.9 GHz. Alternatives can be used if necessary – dependent upon Universal Software Radio Peripheral (USRP) motherboards
Bandwidth	Up to 20 MHz
Peak Input Power to Antenna	50mW
Antenna polarization and gain	Linear, Peak Gain 2.2dBi, Ave Gain -1.0dBi
Waveforms (modulation type)	OFDM

Technical Significance

Address the technical significance of the demonstration/experiment.

Description of the technologies

The demonstration illustrates a dynamic spectrum access network which does not require the use of a control channel or indeed a static channelization scheme for network formation, rendezvous or link maintenance. This is achieved through the use of cyclostationary signatures embedded in OFDM-based waveforms. A dynamic OFDM waveform is used in which the operating frequency and bandwidth can be dynamically adjusted. In this way the waveform can be adapted to the properties of the idle spectrum resources being exploited. Cyclostationary signatures embedded in the transmitted waveforms permit receiving devices to perform signal detection and waveform recognition prior to parametric reconfiguration and signal demultiplexing and demodulation. Network nodes are implemented using a highly reconfigurable software radio architecture upon a general purpose processor (GPP) – based platform. The Universal Software Radio Peripheral is employed as a reconfigurable RF front-end.

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

The potential benefits of DySPAN systems are considerable. However, so too are the technical challenges involved in the implementation of robust networks capable of dynamically adapting to use temporarily idle spectrum resources. While the challenges of white space spectrum detection are well-recognized, the challenges of DySPAN rendezvous and coordination have not yet been addressed. The issue of rendezvous and coordination arises in DySPAN systems due to the use of operating parameters which are dynamically reconfigured during the course of operation. As these parameters cannot be known in advance by nodes of the network, the challenge of network formation, rendezvous and link maintenance must involve signal detection and waveform recognition in addition to parametric reconfiguration.

This demonstration highlights the challenges of DySPAN network formation, rendezvous and link maintenance and presents a solution using intentionally embedded cyclostationary signatures. Through the use of cyclostationary signatures, the requirement for static control channels or channelization schemes for DySPAN systems can be overcome.

Technical Maturity and Operational Capabilities

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

Current state of the technology, hardware, and software

DySPAN nodes using dynamic OFDM-based waveforms have been implemented upon the CTVR platform and a number of applications including live video streaming have been demonstrated using those nodes. Furthermore, the use of embedded cyclostationary signatures in data-carrying waveforms has been demonstrated and used for point-to-point rendezvous. These demonstrations have been carried out in Ireland using over-the-air signals within the CTVR licensed bands at 2.35GHz.

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

1. Implementation of a receiver using embedded signatures for bandwidth estimation.
2. MAC-layer functionality supporting a network of 3 or more devices rather than a simple point-to-point link.
3. Radio scene analyzer for DySPAN nodes using simple energy detection.

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

Configuration scripts to be used to restrict operating frequencies of DySPAN devices.
Full testing of all devices to be carried out in advance using Anritsu MS2721B spectrum analysis equipment.
Coexistence testing to be carried out in advance using heterogeneous co-channel devices.

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

Demonstration equipment previously used at DySPAN 2007, Dublin and SDR Forum Tech Conference 2007, Denver. In both cases, systems were used in coexistence with numerous co-located demonstrations.

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)	2-3 sq. m
Number of demonstration tables required	1
Input power requirements and number of outlets (note: US uses 120V, 60 Hz power with a NEMA 5 (flat 3-prong) plug)	At least 8 outlets required
Approximate power consumption	About 300 - 400 W
Storage and security requirements for equipment	Secure storage required for laptops, RF-front ends and spectrum analyzers.
Instrumentation and other support equipment requested of DySPAN	None
Internet/network access (wireless, wired, number of ports, etc.)	Wireless or wired – 1 port essential, up to 3 or 4 would be good
Other needs	

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.

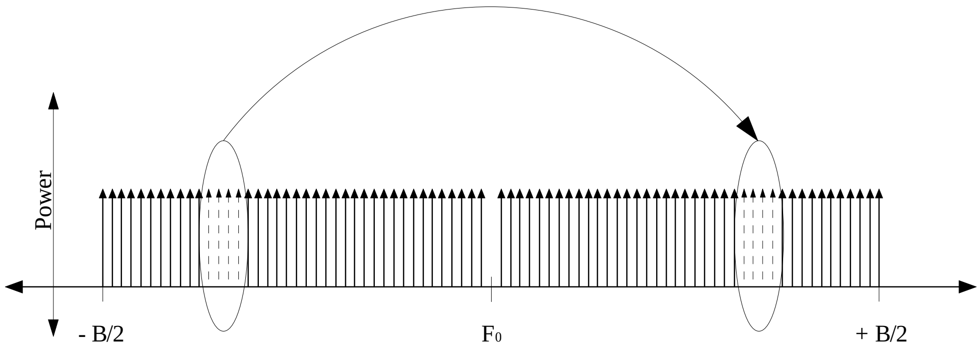
Power
- B/2
F0
+ B/2

Fig.1

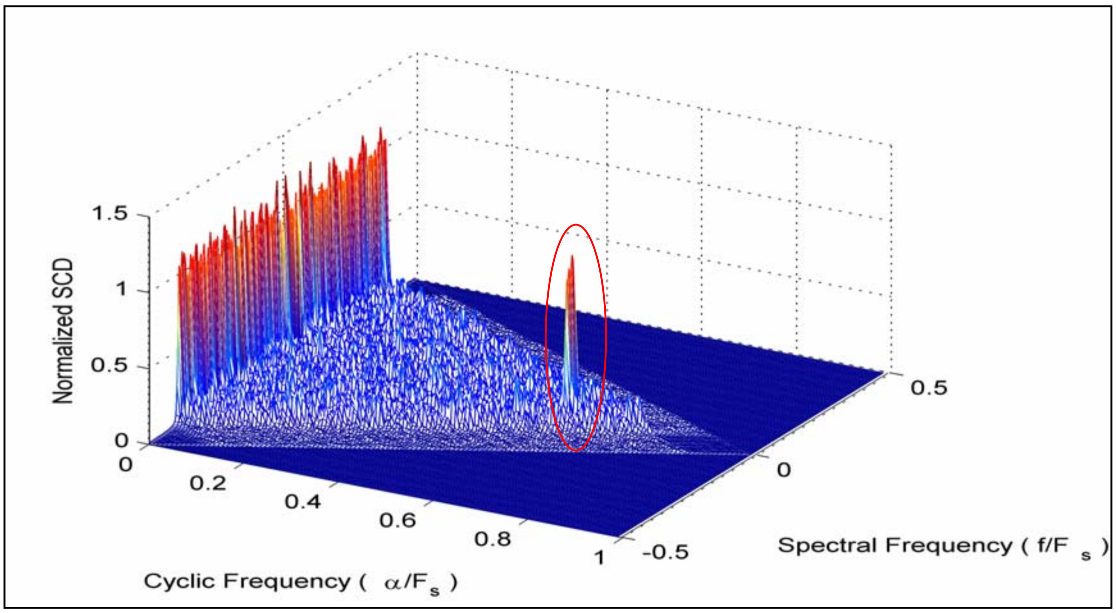
Normalized SCD
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
-0.5
0
0.5
Cyclic Frequency (α/Fs)
Spectral Frequency (f/F s)

Fig.2