by
Joan Lyman

THE ABC OF WIRELESS DMX SYSTEMS

THE LIGHTING INDUSTRY IS NO STRANGER TO ACRONYMS. BUT JUST KNOWING WHAT LETTERS STAND FOR IS NOT ENOUGH, AND THE ADVICE OF A SALES PERSON IS NOT ALWAYS RELIABLE. SO WHEN THE TIME COMES TO SHOP FOR A SYSTEM TO ACHIEVE WIRELESS DMX (DIGITAL MULTIPLEX) HERE ARE A FEW ACRONYMS WITH WHICH YOU SHOULD ARM YOURSELF...

BY JOAN LYMAN

DSSS vs. FHSS (or AFHSS)
There are two basic ways to transmit data over a defined wide bandwidth. These involve spread-spectrum techniques. It is helpful to know the difference, as these methods are relevant when it comes to interference.
Spread-spectrum techniques are ways in which energy generated at one or more frequencies is spread in either frequency or time domains. This is done to establish secure communications, resist interference, and prevent detection, among other things.

Direct Sequence Spread Spectrum (DSSS) transmissions multiply the data being transmitted by a "noise" signal. This noise signal is a pseudorandom sequence of 1 and −1 values, at a frequency much higher than that of the original signal, thereby spreading the energy of the original signal into a much wider band.
The resulting signal resembles white noise, like an audio recording of "static", except that this noise can be filtered out at the receiving end to recover the original data, by again multiplying the same pseudorandom sequence to the received signal (because $1 \times 1 = 1$, and $-1 \times -1 = 1$). This process, known as "de-spreading", mathematically constitutes a correlation of the transmitted PN sequence with the receiver's assumed sequence.
For de-spreading to work correctly, the transmitting and receiving sequences must be synchronised. This means that the receiver must synchronize its sequence with the transmitter's sequence via some sort of timing search process. However, this apparent drawback can be a significant benefit: if the sequences of multiple transmitters are synchronised with each other, the relative synchronizations the receiver must make between them can be used to determine relative timing, which, in turn, can be used to calculate the receiver's position if the transmitters' positions are known. This is the basis for many satellite navigation systems. DSSS transmission can be found in systems such as Avolites eDMX and Luminex Ethernet-DMX8.

Frequency Hopping Spread Spectrum (FHSS) works by jumping from subchannel to subchannel at a rapid pace, using a pseudorandom sequence known to both the transmitter and receiver. City Theatrical WDS and DMX-Link + Cirronet SEM2411 by Goddard Design use this technique. A variant on FHSS is **Adaptive Frequency Hopping Spread Spectrum (AFHSS)** that intelligently seeks busy channels and purposely avoids them, to further reduce interference. W-DMX by Wireless Solution is the only system that uses AFHSS, with a custom encryption sequence.
Frequency hopping techniques were first used by the U.S. military, since they are difficult to intentionally jam and, unless you know the frequency hopping sequence, practically impossible to listen in on.
Spread spectrum techniques have two main advantages. First, they are more resistant to interference than conventional systems. Second, they can be used to provide multiple access functionality.

Time Division Multiple Access (TDMA) enables a part of the radio spectrum to be used "simultaneously" by having different devices use it at different time instants. This is typically done by

JAPANESE

規定の広帯域幅のデータ送信には基本的に2つの方法があり、いずれもスペクトル拡散技術を使用している。この2つの方式は電波干渉の問題に関連してくるので、違いを知っておくと良いだろう。
スペクトル拡散とは、1つ以上の周波数に出力されたエネルギーをより広い帯域、もしくは時間領域に拡散する方法のことであり、秘匿性が高く、ノイズに強く、傍受を防御するコミュニケーションを可能とする技術である。
直接シーケンス・スペクトラム拡散(DSSS)送信はデータを拡大し、『ノイズ』信号によって送信するものである。このノイズ信号は、元の信号より相当高い周波数における、1と-1の数値による擬似ランダム・シーケンスで、これにより元の信号のエネルギーをより広い帯域にを拡散する。
周波数ホッピング・スペクトラム拡散(FHSS)は、送信側と受信側で規定した擬似ランダム・シーケンスを使い、サブチャンネルからサブチャンネルへと高速でジャンプする方式である。またFHSSの改良型である適応型周波数ホッピング・スペクトラム拡散(AFHSS)　方式では、混雑しているチャンネルを自動的に見つけ出し、ホッピング対象から除外することによって、電波干渉をさらに防ぐことができる。

CHINESE

在限定的波段带宽上，有两种传送数据的基本方式。这妙及到扩展频谱技术。了解其差别很有帮助，在遇到干扰时，这两种方法是互相关联的。
扩展频谱技术是一种方法，用于将一个或更多频率产生的能量在频率或时域中扩展。这样做的目的是建立安全的通信、抵制干扰、防止侦测等。
直序扩展频谱 (DSSS) 传输方式通过“噪音”信号使传输数据量加倍。这个噪音信号采用了 1 和 -1 值的伪随机序列，所用的频率也比原来的信号高得多，由此将原来信号的能量扩展至更宽的波段。
跳频扩展频谱 (FHSS) 的工作原理是，以很快的速度在子通道之间跳跃，使用发送者和接收者都知道的伪随机序列。FHSS 的一个变体是适应性跳频与展频 (AFHSS)。它能够智能化地寻找繁忙频道并特意避开它们，以进一步减少干扰。

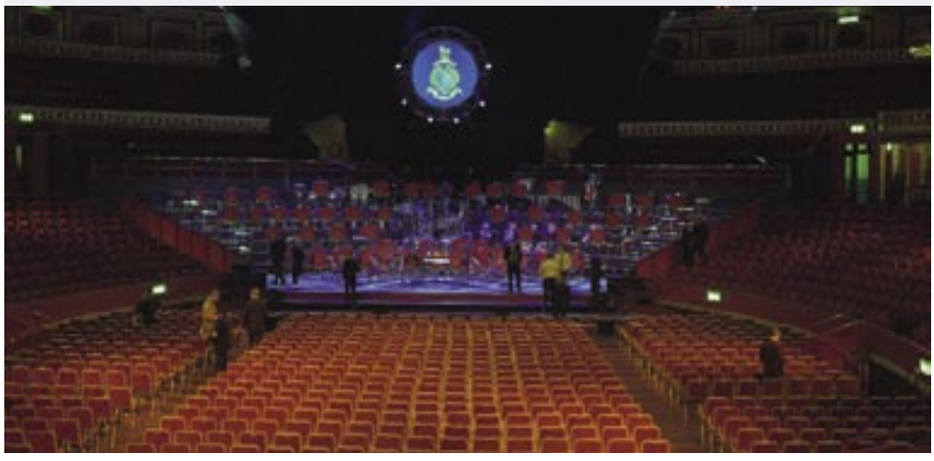
FRANÇAIS

Il existe deux méthodes essentielles de transmission de données dans une bande passante large définie. Ces méthodes comportent des techniques à spectre dispersé. Il est utile de savoir les distinguer, car, sur le plan de l'interférence, ces méthodes sont déterminantes.
Les techniques à spectre dispersé sont des façons dont une certaine énergie, produite à une ou plusieurs fréquences, se répand dans des plages de fréquence ou de temporisation. Leur objectif est d'assurer l'établissement de télécommunications sécurisées, la résistance aux interférences et la prévention de la détection, entre autres.
Les transmissions à spectre dispersé à séquence directe (DSSS) multiplient les données transmises par un signal de bruit. Ce signal de bruit est une séquence pseudo-aléatoire de valeurs 1 et -1, à une fréquence beaucoup plus élevée que celle du signal d'origine, en répartissant ainsi l'énergie du signal d'origine dans une plage beaucoup plus large.
Le spectre dispersé à saut de fréquence recherche, de façon intelligente, des canaux occupés en les évitant délibérément, afin de réduire encore davantage l'interférence.

ROYAL ALBERT HALL, LONDON

A dAFTdATA eDMX system (fully compatible with the Avolites eDMX system) has being installed at London's Royal Albert Hall for the last three years.
The system comprises of four receivers rigged on the main roof trusses and a transmitter that can be moved from the lighting programming position to the operating box.
It has replaced the need for DMX data cables going up to the trusses from front of house, which has reduced both labour time and cable breakages - snapping was a frequent occurrence - when re-rigging in between shows.
Owing to the nature of the Albert Hall's vast array of shows, the wireless system is ideal for rapid deployment, giving fast access to the lighting control system from anywhere within the main arena.
The system was originally specified by Mark Jones when he was a house technician at the venue. The decision to move to wireless was undertaken when Jones specified a new lighting console which allowed them the freedom to programme the lighting from anywhere within the arena. The system is now looked after by Oli Jeffries.
Because both the dAFTdATA and the Avo wireless systems use the worldwide approved Wifi protocol, there are never any compliance or licensing issues with installing the system in any building anywhere in the world.
eDMX is built on wireless Ethernet technologies and as such the system can be linked to existing building infrastructure network cabling systems. As such it provides a perfect solution for permanent installations, where a mixture of wired and wireless solutions can be seamlessly implemented.
Offering full network management and remote device access through dAFTdATA's freeware WENDIHouse, the eDMX system allows for a robust, reliable and flexible wireless data system to be very simply put into action.

www.daftdata.com
www.avolites.com



Useful Links:

www.fcc.gov
www.etsi.org
www.webopedia.com/TERM/D/DSSS.html
www.webopedia.com/TERM/F/FHSS.html
www.webopedia.com/TERM/T/TDMA.html
www.webopedia.com/TERM/E/Ethernet.html
www.usitt.org/standards/DMX512_FAQ.html

Manufacturers websites:

www.avolites.org.uk
www.luminex.be
www.goddarddesign.com
www.citytheatrical.com
www.wirelessdmx.com
www.daftdata.com

allocating specific time slots to the various transmitters. Some wireless DMX systems have adapted the Time Division Multiplexing standards from ATM communication links, designed to transport many simultaneous sessions in links handling massive amounts of data every second. The usage of TDMA fits very well in the DMX situation, where the protocol is required to send several channels in a near-simultaneous way.

IP

Anyone involved with architectural lighting, particularly in outdoor environments, is familiar with IP ratings. Ingress Protection (IP) is the two-digit classification that denotes the protection offered by an enclosure. The first digit indicates protection for persons and equipment. The second digit indicates the protection against water.

For the majority of outdoor applications, a minimum rating of IP65 is recommended. The first digit, 6, indicates that humans are protected against a wire touching dangerous parts, and that equipment is sealed against dust. The second digit, 5, indicates that equipment is protected against low-pressure jets of water from all directions. IP ratings above 65 are only necessary if equipment is subjected to strong jets of water (ship decks or hurricanes) or submersed under water.

Remote Device Management (RDM) is a bi-directional communications protocol developed by the ESTA (www.esta.org/tsp/about/index.html) Technical Standards Program for use in DMX512 control systems. Approved in 2006, it is the new open standard for DMX512 device configuration and status monitoring. Using only the standard DMX512 pair on pins 2 and 3, RDM allows new RDM-aware and legacy DMX512 devices to share the same physical network.

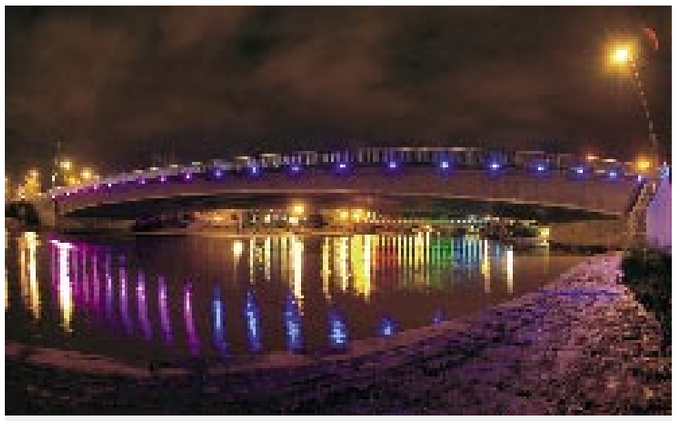
As RDM products begin to enter the market, it is good to know whether or not they will work with your wireless system. If not, you can still send commands, but will miss out on the additional benefits of receiving information back from those units.

ETSI/FCC/ARIB

Because communication regulations vary worldwide, be sure to look for a system that is compliant. The European Telecommunications Standards Institute (ETSI), Federal Communications Commission (FCC) and Association of Radio Industries and Businesses (ARIB) have standards in place in Europe, United States, and Japan, respectively, that require any radio communications to fall within their guidelines. Be sure that the system you plan to use is compliant in the relevant country.

£ / $

Finally, don't let price alone be your guideline. Wireless DMX systems can be like a bottle of wine - the highest price tag does not guarantee the best system. Do your homework on the above and then talk to your local dealer, or call the manufacturer directly.



LIGHT ELEMENTS, MAIDSTONE, UK

The St Peters and Broadway Bridges in Maidstone were brought to colourful - and interactive - life over the holiday season by lighting artist Peter Freeman and Maidstone Borough Council. The new permanent installation project, called Light Elements, makes use of a Wireless Solutions W-DMX system supplied by White Light.

According to Peter Freeman, "the inspiration for Light Elements came from the proximity of the two bridges and how they form a circle of traffic movement around a basin oasis of calm with fishermen and pedestrians on the riverbanks in between. My aim was to create a light installation that would be informed by the structure of the bridges, visually connect the two bridges, and create a dialogue between the bridges and the space between them using reflections and animated coloured light." Freeman also opted to make Light Elements interactive, with the public able to text phrases such as earth, wood, fire and water that trigger different lighting sequences across the bridges.

To achieve this, he installed four runs of DMX-controlled RGB Luxeon LEDs, along each side of each bridge. A control computer receives the commands from incoming text messages and runs the different lighting sequences. The DMX data for these is transmitted using a W-DMX transmitter to three W-DMX receivers fitted with 6db booster antennas to ensure the best possible signal reception.

"The W-DMX system works wonderfully," comments Peter Freeman, "and the results, particularly the reflections in the water, are stunning."

www.peterfreeman.co.uk
www.WhiteLight.Ltd.uk
www.wdmx.com
Maidstone Bridge photo by Peter Freeman

DEUTSCH

Es gibt zwei grundlegende Wege, Daten über eine definierte hohe Bandbreite zu übertragen. In beiden Fällen handelt es sich um so genannte Spread-Spectrum-Techniken. Es ist nützlich, die Unterschiede zwischen den beiden Methoden zu kennen, da sie wichtig sind, um Interferenzen zu vermeiden.

Bei Spread-Spectrum-Techniken werden mit einer oder mehreren Frequenzen erzeugte Signale frequenz- oder zeitspezifisch gespreizt, um beispielsweise ihre Abhörsicherheit zu gewährleisten, um Störsignale zu unterdrücken und eine Erkennung zu vermeiden.

Bei DSSS (Direct Sequence Spread Spectrum)-Übertragungen werden die durch ein „Störsignal" übertragenen Daten multipliziert. Das Störsignal besteht aus einer pseudozufälligen Abfolge der Werte 1 und -1. Die Frequenz ist bedeutend höher als beim ursprünglichen Signal, so dass die Energie des ursprünglichen Signals über eine bedeutend größere Breite gespreizt wird.

Das FHSS (Frequency Hopping Spread Spectrum)-Verfahren arbeitet mit einem raschen Wechsel zwischen den Unterkanälen, unter Verwendung einer pseudozufälligen Sequenz, die sowohl dem Sender als auch dem Empfänger bekannt ist. Eine Variante des FHSS-Verfahrens ist AFHSS (Adaptive Frequency Hopping Spread Spectrum). Dabei wird auf intelligente Weise ermittelt, welche Kanäle besetzt sind; diese werden dann vermieden, um die Interferenzen weiter zu reduzieren.

ITALIANO

Esistono due modi per trasmettere dati su banda larga ed entrambi utilizzano la tecnica a spettro espanso. È utile sapere in cosa differiscano, in quanto entrambi sono rilevanti in termini di interferenza.

Le tecniche a spettro espanso permettono di distribuire l'energia generata a una o più frequenze su diversi domini di frequenza o di tempo, consentendo, fra l'altro, di stabilire comunicazioni sicure, eliminando le interferenze e prevenendo indebite intercettazioni.

Le trasmissioni DSSS (dispersione in banda base) moltiplicano i dati trasmessi da un segnale debole, una sequenza 'pseudo-random' di valori 1 e -1, in una frequenza molto più elevata del segnale originale. Ciò consente di distribuire l'energia del segnale originale su una banda molto più ampia.

La tecnologia FHSS (dispersione di spettro a salto di frequenza) è ottenuta facendo saltare il segnale da un sottocanale a un altro, ad alta velocità, secondo un flusso pseudo-random noto sia al trasmettitore che al ricevitore. Una variante della FHSS è l'AFHSS (dispersione di spettro a salto di frequenza adattiva), una tecnologia che ricerca ed evita i canali occupati per ridurre ulteriormente le interferenze.

Hay dos formas básicas de transmitir datos con un

ESPAÑOL

ancho de banda grande definido que implican técnicas de expansión de espectro. Resulta útil conocer la diferencia, ya que estos métodos son relevantes en lo que a interferencias se refiere.

Las técnicas de expansión de espectro son formas en las que la energía generada en una o más frecuencias se expande en dominios de frecuencia o tiempo. Esto se hace para establecer unas comunicaciones seguras, resistir las interferencias y evitar la detección, entre otras cosas.

Las transmisiones Direct Sequence Spread Spectrum (DSSS) multiplican los datos que transmite una señal de "ruido". Esta señal de ruido es una secuencia pseudo-aleatoria de valores 1 y -1 a una frecuencia muy superior a la de la señal original, expandiendo así la energía de la señal original en una banda mucho más ancha.

Espectro ensanchado por salto de frecuencia (FHSS) funciona saltando de un subcanal a otro a un ritmo rápido, utilizando una secuencia pseudo-aleatoria conocida tanto por el transmisor como por el receptor. Una variante del FHSS es el espectro adaptativo ensanchado por salto de frecuencia (AFHSS), que busca inteligentemente canales ocupados y los evita intencionadamente para reducir aún más las interferencias.