ISCE

The magazine of the Institute of Sound and Communications Engineers

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ISCE

Inside this issue

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Introduction from our President

Anthony Smith *MInstSCE*

Where has the time gone? Not five minutes ago, I was writing December's introduction and it's now March and Spring is well on the way!

The last three months have been a rollercoaster, with Intersec Dubai, ISE Amsterdam (where ISCE had a stand) and of course our very own ISCEx show.

My heartfelt thanks to Ros and Phil for organising a very successful event at Coombe Abbey, with the AGM and networking dinner on the Tuesday and the exhibition and seminars on the Wednesday; on the subject of the seminars thanks also to Helen Goddard for chairing the seminars again with her usual flair.

Whilst I am on thanking people, a big thank you to Malcolm et al at Cunnings Recording for providing the sound systems for free, once again – it is much appreciated. My thanks to Alan March who presented a very informative talk on RF Spectrum issues to our members after the AGM. Of course, also a big thank you to all the exhibitors. Without you, we could not manage to do the show and seminars in the first place.

The networking dinner was very well attended, with over 90 guests. An excellent meal and comedian rounded the event off nicely, and this looks like it will be the regular feature we all hoped it would be.

Looking forward, hopefully you will be registering with the online payment scheme for the membership fees, which although we have raised them this year, still represent great value, and with the increased training content this year, I hope you will recoup more benefits than the increase.

It only remains to wish you all well and to have a happy and prosperous new financial year, and enjoy the Spring magazine.

Anthony Smith ◆

We welcome your contributions to the magazine with editorial and advertising.

Please send news or articles to **Ros**

Forthcoming events diary

15–18 April 2015
Prolight & Sound 2015
Frankfurt

28 April 2015
ISCE Training – Designing for Speech Intelligibilty

12 & 13 May 2015
PLASA Focus –
Royal Armouries Museum, Leeds, UK

21 May 2015
ISCE Training – Sound Measurement Techniques

16–18 June 2015
Firex
ExCel, London, UK

12–14 September 2015
BPM/Pro
The NEC, Birmingham, UK

700 MHz – a digital dividend too far?

Alan March *MInstSCE*

Introduction

On 19 November 2014 Ofcom, the UK spectrum regulator, announced its intention to clear existing users – primarily digital terrestrial television (DTT) and program making and special events (PMSE – wireless microphones, in-ear monitors and some talkback) out of the block of spectrum 694 – 790 MHz, commonly referred to as the 700 MHz band. These existing users have been operating in this band for in excess of 40 years but must, it would now seem, make way for the provision of additional mobile broadband services, for delivery to your smartphone/tablet by the Mobile Network Operators (MNOs). In the case of DTT, this will translate to replacing a free to air television service with a chargeable broadband service on these frequencies. Coming on top of the relatively recent 800 MHz clearance, the nett result will be 168 MHz of prime spectrum being taken away from Broadcasting and Services Ancillary to Broadcasting (SAB/PMSE). Ofcom UK's decision, when implemented, will have profound consequences not only to the broadcast and entertainment sectors that concern themselves with the creation, distribution and export of content, but also for the citizens and consumers here in the UK and abroad, who take great pleasure in consuming that content.

Some history

Many years ago, when the PMSE sector began discussions with Ofcom, there was much talk of how the regulator had to be seen to be 'fair, reasonable and non-discriminatory'. This decision feels far from that approach, informed as it is by questionable results of studies commissioned by the regulator, from organisations who cite the mobile sector as some of their largest day to day clients. In the PMSE sector's view, the overstated estimates of future data demand – a core argument as to why the mobile sector requires access to more spectrum – come from outdated and biased reports. More recent studies suggest that, in fact, data demand growth is slowing while the penetration of, for example, mobile handsets, would appear to have peaked.

Real world requirements

The debate over just how much spectrum is required by the mobile sector is a heated one. Many believe that MNOs already have plenty of existing spectrum holdings which, if re-farmed sensibly, would constitute more than enough capacity to meet mobile data demand both now and well into the future. Indeed, at a recent Ofcom Stakeholder meeting one MNO (EE) publically stated that the mobile sector ▸

already has enough spectrum and that they (the MNOs) just needed to 'move the data around the networks better'. However, this point appears to have been lost on Ofcom who, having spent many years and taxpayers pounds working towards this decision, despite trying to appear neutral, now seem to be in no mood to recognise that things might have moved on.

Policy drag

The world of spectrum management moves incredibly slowly. This can have the negative effect of slow to be arrived at policy decisions being overtaken by technological and/or political developments. Are we looking at an example of this here? The technologies employed today by the mobile sector are light years away from the technologies that were in place when the potential clearance of the 700 MHz band was first mooted. Additionally, enabling roaming across each other's networks would significantly increase capacity without the need to allocate even more spectrum to the MNOs. This point, again, would appear to have been overlooked.

Technology acceleration

Meanwhile, technology continues to develop. There is already much talk of 5G which most expect to be operating in the GHz frequency bands, not UHF. Are we going to go through all of the not inconsiderable cost and inconvenience of clearing the 700 MHz band, only to find a few years down the line, that it is not really required due to the relentless march of technology? This is a very real possibility and, once again, has been innocently not considered by the regulator at best, deliberately ignored at worst.

The wrong end of the telescope?

There are a number of ironies associated with this decision. Firstly, the claimed increase in data demand, by the MNOs' own admission, is film and video content. This decision will, perversely, remove access to the very spectrum band that is critical for the production of the most vibrant, exhilarating and exciting of this content. It follows that consumers will have no desire to download unexciting, drab program material. It is the use of wireless production tools (wireless mics and in-ear monitors, in particular) that facilitate the making of the kind of content that users expect and demand. It seems that radio frequency (RF) content delivery platforms are being allowed to take precedence over content creation RF ecosystems. In simple terms, this decision runs the risk of us ending up with a large delivery pipe but with nothing of any quality to send down it. Secondly, one of Ofcom's, or indeed any regulator's, prime responsibilities is to minimise the amount of interference between conflicting or competing services. In this decision Ofcom admits that some people will be inconvenienced by interference to their DTT reception and does its best to downplay the numbers of people that will be adversely affected. While it is recognised that there is a difficult line to tread between 'making the most efficient use of a finite resource' and 'interference management' perhaps the proposed band plan, in this instance handsets and mobile devices at the bottom of the band, might not be the best way forward. Are we about to enter a world whereby in order to watch DTT interference free, you (and possibly your neighbours) will need to switch-off all mobile phones?

Sphere of influence

This decision has not been arrived at by accident. For many years there has been a consistent dialogue between the mobile sector at all levels of spectrum management; from the International Telecommunications Union (ITU – the highest level of spectrum management), down through the regions and deep into the hearts and minds of national regulators. Meanwhile, the broadcast sector has been asleep at the wheel, believing that broadcasting in general and DTT in particular, is sacrosanct. This decision should awaken the broadcast sector with a start. There are individuals and organisations in this wide and diverse debate who regard the very concept of free to air TV as anathema. People with this mindsetwould like nothing better that to switch off DTT in order that the only way to receive media content, in whatever form, would be across consumer subscription networks. While heartening that in this decision Ofcom have recognised the value of DTT and imply that it is safe until at least 2030, a watchful and vigilant eye should be kept on developments in this area. The pressure will remain – and the public should be aware. ▸

The right move?

In conclusion, is the 700 MHz band clearance a 'digital dividend too far'. The PMSE sector holds that it is and that not enough has been demanded of the MNOs to get their own houses in order before giving them – in all likelihood, in perpetuity – such a valuable prize. This could be viewed as a 'land grab' on behalf of the mobile sector, pure and simple. A land grab predicated on perceived 'benefits' to citizens and consumers that they do not really need and, in reality, are unwilling to pay for. All this at the cost of the capping of any future growth in the free to air TV sector and imposing serious costs and constraints on the industry's ability to make content of the quality that consumers have come to expect. For HM Treasury perhaps this decision also represents a mechanism for extracting revenue from organisations that are ruthlessly efficient when it comes to minimising their tax liabilities. Surely it would be better to reform the MNOs' tax arrangements to ensure a regular annual income of revenue, rather than going after a one off payment – which the MNOs will ensure is as minimal as possible.

Ofcom and HM Government will, no doubt, not subscribe to the views expressed above. However, there are two sides to every fence and at present, on our side, things are looking pretty bleak. Being evicted when PMSE has done nothing wrong and, in reality, has actually played a significant part in contributing to UK PLC feels deeply unjust. If eviction itself was not bad enough, then only very loose promises on where we may be able to move to in the future and obfuscation on whether or not, when the time comes, there will be any financial assistance, compounds the feeling of betrayal. At present the only alternative frequency bands 'on the table' would involve PMSE sharing with either the Civil Aviation Authority (690 – 1164 MHz) or the Mobile Satellite Service (1525 – 1559 MHz). What if both incumbent users say no? What if they say yes in principle, but in practice things prove to be unworkable? Is there a plan B? At present, it would appear not – and meanwhile, the 700 MHz clearance bus rolls on.

Ofcom UK has stated on numerous occasions that 'we would never do anything to harm the PMSE sector'. This decision and all the uncertainty that is caused by it, when paired with their clear intention to allow white space devices into what remaining UHF spectrum is left, currently makes those words look very, very hollow indeed. ◆

The visual microphone: passive recovery of sound from video

David Milligan MInstSCE of Network CDI, would like to share this fascinating YouTube link with you.

While still in the development stage, it could have many uses if further research and development was carried out.

www.youtube.com/watch?v=FKXOucXB4a8

John Caton *MInstSCE* brings 30 years of audio system design experience to the AECOM Acoustics team

AECOM is thrilled to announce the recent appointment of John Caton as Associate Director in the Manchester office. John will be working in the Acoustics team specialising in electro-acoustics in which he has a wealth of experience in the design and installation of audio visual systems spanning over 30 years.

Mike Hewett, Head of AECOM Acoustics in Manchester, says "We are over the moon that John has joined the AECOM team. He has already proved to be an invaluable addition to AECOM's electroacoustic design offering and his skills perfectly complement those of Jim Smith who heads the Manchester Electro-Acoustic team. We look forward to exciting times ahead strengthening AECOM's position as a major force in electro-acoustics"

John says "I am delighted to have been given the opportunity to join the highly respected AECOM Acoustics team and look forward to help them strengthen their position further in the electro-acoustics sector"

John is highly respected in the audio visual system community with considerable experience in the sports industry having been responsible for the design, installation and maintenance of sound systems at many UK football, rugby and cricket grounds. Many of the UK's major stadiums have systems designed by John in place including both the Anfield and Goodison stadiums in Liverpool, Newcastle United FC, Manchester City FC, Blackburn Rovers FC and many more. He was also very involved in systems for the Euro 96 and Commonwealth Games of 2002.

In addition to Stadia, he has a wealth of experience in many other areas, ecclesiastical work includes Blackburn Cathedral, many churches, mosques and crematoria, hospitality includes the Michelin starred Northcote Group, retail includes IKEA to name a few. John was also the first none Bose employed person to take their Modeler and Auditioner ® training symposium in Boston.

John Newsham, Risk Consultant and previously Stadium Manager at Blackburn Rovers FC, says "John will be a great asset to AECOM, I have known him professionally for over 20 years and his technical and practical knowledge and skills during my time as Blackburn Rovers Stadium Manager and now as an independent consultant, are and have been extremely useful to me professionally".

AECOM is a premier, fully integrated professional and technical services firm positioned to design, build, finance and operate infrastructure assets around the world for public and private sector clients. With nearly 100,000 employees – including architects, engineers, designers, planners, scientists and management and construction services professionals – serving clients in over 150 countries around the world.

www.aecom.com ◆

A long look at amplitude distortion – Part 1

John Woodgate *HonFInstSCE*

Amplitude distortion is, of course, what most people mean when they talk about 'distortion'. It is also called 'non-linearity distortion'. This gives a clue to its direct cause: the output is not exactly proportional to the input. However, small deviations from proportionality or linearity, practically invisible on a graph of output versus input – a 'linearity curve' - cause significant amounts of distortion, so it is usually not helpful to consider the linearity curve in depth. Figure 1 shows a linear response – ($v_1 = x$) and a non-linear response – ($v_2 = x - 0.05\,x^2$). Note that it is normal for the response to fall below strict proportionality at high signal levels – this is called 'overloading'. In general, even harmonic terms are negative and odd harmonic terms are positive.

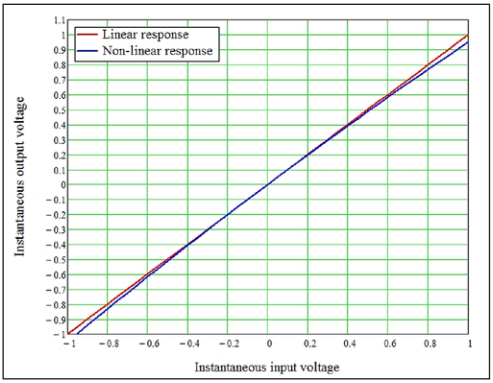

Fig.1 Example of a linearity or transfer curve

The usual approach is to consider what happens to a sinusoidal signal when it is applied to a device (amplifier or transducer) which exhibits non-linearity. There's always a choice here – do we use the cop-out phrase 'It can be shown...' or delve into the algebra? On the basis that no-one has been permanently injured by a 'cos' let us use it without fear, although 'sin' may result in retribution, 'tan' may result in painful ecdysis, and we should avoid 'cosh' for fear of the long arm of the law.

So, suppose we have a device for which the output v_o is related to the input v_i by:

$$v_o = v_i - 0.05\,v_i^2$$

The squared term represents the small amount of non-linearity, as shown in Figure 1. We apply a sinusoidal input signal, and find that the output signal is given by:

$$v_o = V_i\,(\sin\omega t - 0.05\sin^2\omega t) =$$
$$V_i \sin\omega t - 0.025V_i + 0.025V_i\cos 2\omega t)$$

Two new signals have appeared: $0.025V_i$ is a *d.c. voltage*, which probably stops at the next coupling capacitor in the circuit, while $0.025V_i\cos 2\omega t$ is a signal at twice the original frequency and is in fact 2.5% of second-harmonic distortion.

If our device had a cubic or 'third-order' term instead of a squared or 'second- order' term, we would get a third-harmonic signal and a small extra amount of fundamental. This sort of non-linearity is shown, for example, by a push-pull amplifier, such as an audio power amplifier IC, just on the verge of clipping. Driven a little further into clipping and the sharpness of curvature of the linearity curve rapidly increases, generating all odd-harmonic components up to very high orders. The audible effects of this procession of odd harmonics are unpleasant. But low-order harmonics, both odd and even, have much less damaging effects on single sinusoidal signals. After all, musical instrument sounds (with a few exceptions) are rich in harmonics.

The situation changes with real-world signals that have a broad spectrum. It is difficult to deal with broad-spectrum signals mathematically, because the expressions rapidly become huge, but we can get a simplified idea of what goes on by considering just two sinusoidal signals, applied to our original non-linear device:

$$v_o = V_i\,(\sin\omega_1 t + \sin\omega_2 t + 0.025(\sin\omega_1 t + \sin\omega_2 t)^2)$$

If we keep all the terms in that equation, it will soon get very long. If we multiply out the squared term, we get a product term in the middle:

$$0.05\sin\omega_1 t\,\sin\omega_2 t = 0.025\{\cos(\omega_1 - \omega_2)t - \cos(\omega_1 + \omega_2)t\}$$

Two new frequencies have appeared, corresponding to the sum and difference of the original frequencies. For example, if the original frequencies were 440 Hz and 500 Hz, the new frequencies are 60 Hz and 940 Hz, as shown in Figure 2

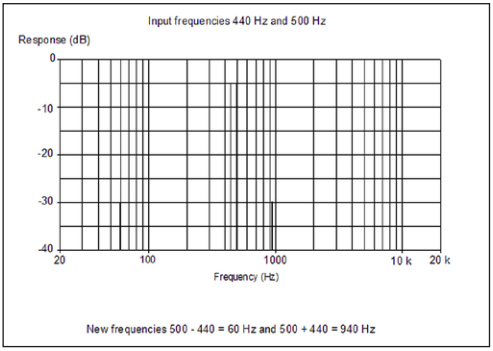

Figure 2 Second-order intermodulation distortion

Neither of these is harmonically related to the original frequencies, so they are musically discordant. If we have third-order non-linearity, we get new frequencies $2\omega_1 \pm \omega_2$ and $2\omega_2 \pm \omega_1$. If one of the original frequencies is much lower than the other, two of the new frequencies are closely spaced on either side of the higher frequency – they are the sidebands of an amplitude-modulated signal: the higher frequency has been amplitude-modulated by the second harmonic of the lower one. For example, if we originally had 60 Hz and 5000 Hz, the new frequencies would be -4880 Hz and 5120 Hz. The negative sign on the lower frequency is of no significance for us here; our 5 kHz signal is amplitude-modulated at 120 Hz, as shown in Figure 3.

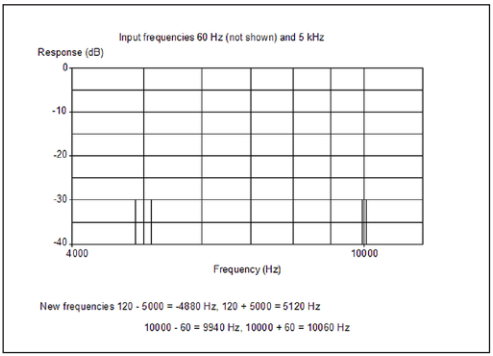

Figure 3 Third-order intermodulation distortion; widely-spaced input frequencies

The other pair of signals would be 9940 Hz and 10060 Hz - the second harmonic of 5 kHz (which is also present because of the second-harmonic distortion), double-sideband modulated at 60 Hz. These amplitude-modulated signals sound very 'rough', and are much more subjectively repellent than low-order harmonic distortion.

If, on the other hand, the two original frequencies are nearly equal, new frequencies lower and higher than the originals are produced. For example, 490 Hz and 500 Hz produce signals at 1490 Hz, 1480 Hz, 480 Hz and 510 Hz .The 10 Hz difference frequency is, we hope, not amplified, because for sure the loudspeaker won't like it! Figure 4 shows the result.

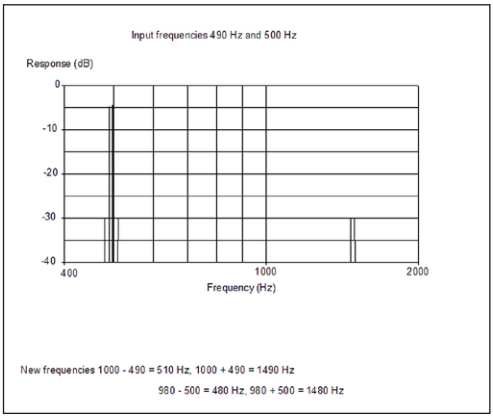

Figure 4 Third-order intermodulation distortion; closely-spaced frequencies

These are excruciatingly not harmonically-related and the audible effect can be very bad indeed. When one recalls that these are the effects of *intermodulation distortion* produced by only two signals, and then imagines what happens with real programme signals, It can be seen that it is very likely *this* effect, and *not* harmonic distortion which is so destructive of sound quality. That 'very likely' is because I haven't found any report of subjective tests that confirm it, but a reliable test result that refuted it would be an astonishing development.

Intermodulation distortion is divided into *modulation distortion*, where we have one low and one high frequency signal, and *difference-frequency distortion*, where the two signal frequencies are nearly equal. Modulation distortion is usually caused by power-supply defects and signal transformers (if there are any) saturating at low frequencies. Difference-frequency distortion is caused by device ▸

non-linearity. It can be used to determine non-linearity at high frequencies, where harmonics are beyond the pass-band of the device being measured. For example, measuring a device with an upper frequency limit of 20 kHz cannot give a meaningful result for third harmonic distortion for any frequency above 6.3 kHz, whereas difference-frequency distortion can give a meaningful result for test signals of 19.5 kHz and 20 kHz.

Amplifier specifications

Here are three amplifier output power specifications:

10 W at 0.25% total harmonic distortion

30 W at 0.45% total harmonic distortion

100 W at 2.2% total harmonic distortion

Which one would you choose to run ten loudspeakers tapped at 5 W?

Actually, it doesn't matter, because they are just three measurements on the same amplifier! We can see what is going on by considering the distortion versus output voltage and power characteristics shown in Figure 5.

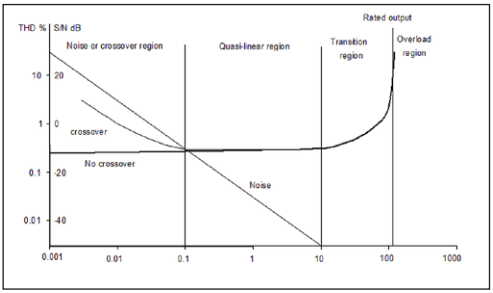

Figure 5 Output voltage and power characteristics

NOTE If that figure looks familiar, it is the original; that in BS 6259 is a copy.

Although it is almost universal practice these days, it isn't sensible to quote rated output at a very low value of total harmonic distortion, because it doesn't give a useful indication of the real capability of the amplifier. The largely discredited '10 % THD' really does give a good indication of the *maximum useful output* of an amplifier (and how likely it is to damage loudspeakers), but it doesn't tell us much about how 'clean' the reproduction is. For that, amplifier buyers should look at the distortion produced at one-tenth of the rated output power and at lower levels, assuming that the amplifier manufacturer is kind enough to give us the necessary data.

Here are two more specifications, relating to 100 V line amplifiers:

0.1 % total harmonic distortion at 30 V

0.5 % total harmonic distortion at 30 V

These are NOT the same amplifier. Under normal speech and music conditions, the amplifier is likely to spend a lot of time producing signals 10 dB below full output, or less. So the amount of distortion at 100 V – 10 dB = 31.6 V (say 30 V) is very significant, and the amplifier with lower distortion is better, at least on that account. Of course, it might cost more....

Next time

In Part 2, we will look at a crucial factor in analysing distortion with feedback – that we can't assume that the forward gain of the amplifier is constant and at the same time make it non-linear, dependent on the instantaneous input signal amplitude. There will also be some results of simulations – the results from real circuits are just too complicated to discuss without reams of mathematics. ◆

Speaking wirelessly

In this third instalment of this min-series, Jason Williams MInstSCE provides the facts about using wireless technology in the conference room, discusses the advantages and disadvantages of different technologies, and gives some useful tips and advice on about how to get the best from your wireless discussion system.

Episode 3 – the beginners guide to Gigahertz – part one

Since I started writing this mini-series back in July, I've been busy visiting trade shows, delivering seminars and attempting to educate the industry in how best to use wireless audio technology in the conference industry. At the same time I have been learning from radio users and suppliers about their positive and negative experiences of operating systems wirelessly.

In this episode we are going to explore the technology behind what makes a wireless device wireless.

The heart of any wireless device is its radio system. Even an infra-red system transmits radio signals, just in a lower part of the electromagnetic spectrum. As you can imagine the part of this spectrum where we transmit radio waves is very busy and in order to manage this wireless highway most countries have a body that controls the traffic.

In the UK our frequency management is controlled by OFCOM who issues licences to radio users for the purposes of radio communications. Licensing can be a complicated, time-consuming and expensive to radio users. However there are some frequency bands which been designated as industrial, scientific, and medical (ISM) bands where don't need a license to operate (subject to conforming to some regulations such as output power and operating frequency) which is what make these bands so attractive to the manufactures of wireless technology.

I'd like to explore wireless radio systems which operate in two of these most popular bands 2.4 GHz & 5.0 GHz but before we progress any further let's pause for a short recap on some basic physics. Radio waves as I mentioned earlier, are a form of electromagnetic radiation which have wavelengths longer than infra-red light from millimetres to kilometres with frequencies ranging from hundreds of gigahertz to as low as several thousand hertz. Depending on frequency some radio waves can propagate through the atmosphere differently to others and this affects how far they can travel and how easily they can be bent or reflected. Due to the nature of radio waves they can be very susceptible to interference and also be a source of interference themselves.

Through the popularity of manufactures attracted by producing wireless products operating on the license free ISM bands particularly 2.4 GHz the wireless market has reached a saturation point. Just look at the wide range of devices available for an increasing number of applications.

Let's imagine that a new conference centre is being built and the owners want to equip it with the latest cutting edge and innovative technologies to increase its customer base and maximise its income:

New conference centre technical specification

Wi-fi access points	2.4 GHz/5.0 GHz
CCTV surveillance	2.4 GHz
Projector for wireless presentations	2.4 GHz
Wireless conference system	2.4 GHz/5.0GHz
Wireless voting system	2.4 GHz
Intercom system	2.4 GHz

All of a sudden we have a larger number of devices all trying to utilise the same band and the likelihood of congestion is quite probable. Add to this the numerous users of this high-tech facility who will no doubt have their own BYOD devices such as mobile phones, tablets, and laptop computers creating their own wi-fi clouds and this issue could get more complicated.

Is there a way to try and reduce the possible congestion of radio traffic in this scenario and allow all these devices to work in harmony with each other?

Find out in part two! ◆

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Tue 3 – Wed 4 March

BEST EVER

> *ISCEx2015 was definitely the best yet. I was really impressed by the venue, with excellent food contributing to a great networking dinner. The show is now, without doubt, the most concentrated audio exhibition in the UK, with a wide variety of brands, with enough time to speak to everyone. I am sure it was good for all the guests and also for the exhibitors, with its low stress level and cost. I look forward to going back next year.*

Neil Voce, ASL

> *This is the first time Midwich have exhibited at ISCEx2015 and we will definitely be booking again in 2016. There was good attendance from visitors who were relevant to our industry and the event was really worthwhile.*

Alison Charters, Midwich Ltd

> *ISCEx2015 provided an opportunity to talk to fellow ISCE members and other associates, some of whom I have known for thirty years. Coombe Abbey was a very impressive location and provided a relaxed and comfortable setting to meet up with institute and industry colleagues. I was impressed to see so many exhibitors showing a diverse range of products. The seminars too were well attended and offered excellent lectures on a number of relevant topics. Well done ISCE in organising a memorable event.*

Gerard McKeown,
MGA Communication Ltd

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ISCEx2015
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ISCEx2015 presentations

At ISCEx2015, Phil Price, Vice President of ISCE, was privileged to present plaques to our newest supporting members and have the opportunity to publicly thank them for supporting the ISCE.

Andy Barnby of Clever Acoustics

John Oliver receiving the award of Honorary Fellow from Tony Smith, President of ISCE

> *"This honour was totally unexpected and my surprise complete. I trust that I can live up to the award and continue to contribute to the development of the ISCE."*
>
> **John Oliver HonFInstSCE**

Chris Hales of Atkins Acoustics, Noise & Vibration

David Boxall of Baldwin Boxall Communications receiving the award of Fellow from Phil Price.

Bob Stewart of VP Bastion

New Supporting Member

We are delighted to welcome VP Bastion as a new supporting member with the ISCE.

VP Bastion was formed with the acquisition of Bastion Joinery by Voice Products in September 2013. We have, for over of 25 years, been trading and providing voice solutions to businesses and companies.

We have experience in providing reliable, cost effective audio solutions to central government departments and local authorities throughout the United Kingdom.

Using the thorough understanding we have in our areas of specialism, our aim is to help select the right products and services for our customers while ensuring the selected products will integrate with other existing systems to deliver real process efficiencies.

VP Bastion has always employed our own security cleared in-house engineers, fitters and project managers to assure the quality of our implementation and maintenance support services.

With the increasing portfolio of audio technology, and related additional product disciplines, it is of paramount importance companies continue to invest in training and build an affiliation with companies offering value added membership schemes. We therefore feel the ISCE is a perfect match to allow us to reinforce our professionalism via its membership scheme.

Andrew Raby
Technical Service Manager, VP Bastion Ltd
www.vpbastion.co.uk ◆

ISCE
The Institute of Sound and Communications Engineers
Supporting Member
Committed to technical excellence

Tax rebates for innovative thinkers

Do you know about the RDTC scheme and how you can get cash for your innovation?

The UK government operates a scheme to put cash back into companies, small and large, who are innovative; it is called the Research and Development Tax Credit scheme.

Research and development is not all boffins in white coats, not even is much of it 'rocket science'. It is about activities undertaken to develop innovative solutions to problems, it is about overcoming technical uncertainty, it is about advancing knowledge.

All of these are activities that companies, like yours, who are moving forwards, are familiar with. But not many company accountants are. If you have made 'an advance in overall knowledge or capability in a field of science or technology through the resolution of scientific or technological uncertainty' then it is highly likely that you can qualify for government cash. Most of the companies we have helped, were told by their professional advisors or accountants that they were not eligible, but we have succeeded in helping them claim thousands of pounds to boost their development budgets. All it takes is a call or email to us for a chat and we can let you know if you are likely to have a claim.

But act today as the claims have a time limit.

Tony Lord, CEng, MIET, FIIB
Director, Butler Basford & Lord Ltd

Tel: 08450 179737
Email: tony.lord@butlerbasfordlord.co.uk

For more information, please visit
http://itranddtaxcredit.co.uk/ ◆

A list of FAQs can be found on the ISCE website here

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ISCE

The Institute of Sound and Communications Engineers

www.isce.org.uk

Designing for speech intelligibility

Using the speech transmission index

You will learn

- Relevant British and European intelligibility standards
- Intelligibility metrics
- Factors that affect the Speech Transmission Index
- Loudspeaker choice and placement
- Reverberation times
- Direct-to-reverberant ratios
- Signal-to-noise ratios, static and time variant
- Intelligibility limits in an acoustic space
- Measuring the Speech Transmission Index (STI-PA and indirect methods)

Who should attend

Everyone involved in specifying, designing or installing sound systems or voice alarm systems where speech intelligibility is important, including engineers, installers, system designers, estimators, consultants, and local authorities

Entry requirements

A background in audio and A-level maths is desirable, but not essential.

Certification

All delegates will receive a Certificate of Attendance.

Book your place now!

Training Courses

CONTENTS

ISCE's new VA System Fundamentals training course

On 24 February, Bob Howard MInstSCE presented ISCE's new VA System Fundamentals training course at Shure Academy in Waltham Abbey. We are delighted that the feedback from our delegates was so positive. Our thanks to Shure Academy for allowing us the use of their training facilities in Waltham Abbey.

In May 2015 we are planning to run two more training courses: Sound Measurement Techniques and Live Sound Engineering. Make sure you and your colleagues have the opportunity to attend. ◆

> *"Thank you for the training session I attended on VA System Fundamentals. I thought it was excellent and have to say I really enjoyed the day. In particular, I'd like to thank Bob for his patience in answering so many of my questions."*
>
> **Bill Clark, RIBA Enterprises Ltd**

Sound system security in an online environment

Joules Newell *MIOA MInstSCE*

System security isn't really a thing that tends to concern the average audio installer. We often wonder what it has to do with us, but it doesn't take too much thought to realise that it really should concern us, and that it should do from the very first stages of system design and specification, right through to after sales service and maintenance.

Many of us routinely install systems in an environment where malicious interference could cause serious commercial issues for our customers or, in many cases, even cause mass public panic and all the consequences that it brings with it. It wouldn't take too vivid an imagination to consider a disgruntled employee or someone of malicious intent causing the mass evacuation of a major public building or gathering, or to interfere with any business or event through unauthorised access to the sound system. Simply wiping a set of DSP controllers clean of their operating program would be adequate to stop a major sporting event due to the consequences of the lack of adequate functioning safety systems.

In days gone by, this would require a person of malicious intent to actually access the building or the service rooms and physically tamper with the systems. Not so, when we use network controllable units, as access doesn't mean physically being there. In the past, all we had to deal with was physical security that was very effective. Often we don't even bother to consider who or what is controlling our DSP control units and exactly which network we are actually connected to, as long as the network works and the units talk to each other. It can be a huge task in a building-wide system with multiple points of control from multiple types of devices to keep tabs on what links to where. In many cases, it will only take one such device to become compromised in order for the system as a whole to be vulnerable to malicious attack. When we are talking about airports, railway stations, football stadiums, shopping malls and even such critical places as power stations and hospitals, we soon begin to understand the consequences of poor audio system security.

It is so tempting to use buzzwords like ease of control, system interlinking, remote diagnostics, easy mobile device control and many other gimmicks to up-sell a system to a customer in order to win the job, but we often don't think of the consequences of doing so. These consequences are, as yet, only theoretical, I'm not aware of any major hack of a public sound system, but as with any such theoretical weakness, it doesn't take much for it to become a reality, and once it has done it becomes a huge problem. Many critical industrial control system vulnerabilities exist the world over but we only hear of them when their failures have become public news. Such vulnerable systems work happily free from interference for years, due to the simple lack of anybody knowing the vulnerabilities exist, yet we only need to look at the recent malicious PLC viruses to understand that such simple industrial control systems are not immune to attack at all.

Good system engineering and intelligent design involves testing your own systems for weaknesses and fixing the faults before that weakness ever breaks a working system. Identifying insecurities before ▸

they become known can save you from all kinds of serious liabilities later in the day. Lack of understanding of an issue is no excuse for failing to secure the public safety where that risk is real and should be known. The type of systems that audio systems suppliers install, do have the potential to risk life if misused, mass evacuation is never a sure totally safe process and anybody involved in event management knows this, but such a risky situation could be easily triggered from an attack on many of our systems out there. Systems that could accept remote audio signals or streams, or even audio from a locally compromised host computer would be the most insecure of all, almost anything could be injected into the system to cause any form or public reaction.

It is very important that we consider all aspects or what could be done by an intelligent, informed malicious attacker. The first step in any process of securing a system is to make a full assessment of all the possible security weaknesses and all the possible consequences of an attack. In industrial and commercial situations there is often an 'insider' involved, be that a person with a grudge, somebody paid for information, or an infiltrator, but either way if it is known by local staff that a system can be remotely controlled or accessed that is an immediate and very big security weakness. Simply having a system connected to a remotely accessible network is a huge weakness in itself and is the principle weakness in almost all circumstances.

Figure 1 Multiple dedicated audio system network patches in a film studio control rack during installation.

The easiest and safest security method is to not connect a system to any network at all. Really, in any public installation we should be asking ourselves why at every single design stage where we consider linking our systems to outside equipment. Many years ago, I was involved in a project to install a remote access, monitoring, video and diagnostics connection to sound and lighting systems in a very large estate of UK entertainment venues. This was a system where a VPN connection would be made to a local host PC, controlling the venue sound system DSP controller and lighting system controllers. Only once we started dealing with the company's IT security staff did we fully realise the consequences of poor security. Surprisingly to us at the time, their biggest concern was their own staff and especially ex-staff being able to remotely access critical systems, not outside attackers. We were asked some very forthright questions during the subsequent discussions; were our systems immune to remote tampering? Could harm be done by tampering? What were the benefits to this, and were these benefits worth the risk? All good questions. As the benefits in this case were simply reduced service call-out costs, it was eventually decided not to continue with the project as the risks were simply too high. Even just a malicious attacker wiping all the company's DSP controllers of their operating program had the potential to cost the estate many hundreds of thousands of pounds in lost revenue in a single night and would probably take a few nights to fix. All an attacker would need in that case would be a service engineer log in and some other very simple details.

The most effective network security in most cases is no network. Unless the networking is totally essential just don't do it. Think why you really need to network your systems. Are you being lazy? Are you trying to be cool? Are you trying to gain a sales gimmick advantage over your competition? Do the benefits warrant the risk?

Where there is no alternative than to use an IP network, first try to see if there can be a physically isolated separate dedicated local network for the sound system control, a totally physically separate network that cannot easily be connected into the building's main data network without being noticed. If you use IP-based remote control panels and host computers around the venue make sure they are secure and isolated from external networks. Think about where your network connections are and where your central patch is located. Avoid situations where your networks are ▸

adjacent to public network ports. Hard wire network connections into host machines to avoid inadvertent cross-patching by users or intentional insertions of unauthorised access points. Put any wall-mounted RJ45 outlets inside the back-box and fit a single-gang blank plate with patch-cable pass through where you would normally have a surface RJ45 outlet. Always consider robust physical security measures like these. It can even become the case where you will need to pull your own network cables in, even where there is a comprehensive network install being carried out by the main network contractor. I can't begin to count the number of times I have attended problematic installations where the network has been altered by local users in their infinite and superior wisdom. User inference should never be underestimated as a risk.

In many cases, it is worth considering places where a secure physically isolated network can be compromised. The most common of these which goes unseen is nearby wireless network connections. Many computers these days come with pre-installed wireless network cards, and many are easy to activate by the user, sometimes all it takes is a bored operator with minimal IT knowledge and a previously quarantined machine can become a bridge to the public network for their own recreational internet access. In one or two cases, I have seen instances in systems I have serviced which have unused on-board wireless where the original IT system installers have physically cut the cable from the wireless enabled chipset to the antenna to prevent such breaches of security. Also putting the local system control host machine in security enclosures to prevent users connecting unauthorised devices is another good solid security measure.

When it is absolutely required to have maintenance or service access to systems remotely, first think of ways of physically securing this connection and think about how often this connection is needed. I have seen instances where an occasional remote session requires a local user with keys to a machine room be required to go and hard patch a network access cable into a nearby socket before the remote user can access the system. This is stone-age simple engineering, but almost fool-proof. This cable had to be passed through the door and connected outside the machine room so had to be disconnected at the end of the remote access session for the local key holder to close the door – brilliantly simple and effective. It can be far too tempting to leave systems online for ease of occasional service, but such actions can have serious security implications. Think about it first.

If there is no option other than to use continual public network access with your systems, then it is very much advised to consult a specialist network security advisor who can recommend the best ways of ensuring the system is protected from interference.

I don't intend to offer any real answers to the issues here, each situation is unique and often a complex balance, but simply being aware of the potential weaknesses and risks is the single biggest step to making a system secure. Even if you just sit and think if the next system you install will be at risk and you do something about it, we will be one step closer to a more secure industry.

At the moment far too few of us even consider such risks when we design and install our systems. I have to admit to being staggered at the vulnerability of some rather critical systems I have come across in my years of servicing and maintenance visits.

Joules Newell has been involved in the specification, design, installation and maintenance of many networked audio and data systems for public spaces, recording studios, and film studios around the world for the last 15 years. ◆

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