Next-generation audio for live sports broadcast

The roll out of next-generation audio (NGA) for live sports broadcast is gaining traction. In the UK BT Sport and now Sky have adopted Dolby Atmos as their choice of NGA codec for UHDTV broadcast, whilst in South Korea broadcast of MPEG-H began in May this year and planning is well underway for 2018 Olympics coverage using that format. For the last few years sports broadcast demonstrations have been heavily used to showcase NGA formats at trade shows. Live sports appears set to provide the first market-penetration for NGA.

In the UK, adoption by broadcasters has been faster than many anticipated. BT Sport were early to the game, and have broadcast Premier League matches in Dolby Atmos since January 2017 following a successful pilot. Sky have been broadcasting ultra high definition (UHD) content with Dolby Atmos since August 2017 making the UK a key proving ground for NGA sports broadcast, and also for the practical workflow development needed for live NGA production.

Despite this rapid progress, few viewers are yet enjoying the benefits that could stem from the technology. AV receivers and games consoles capable of reproducing NGA in Atmos and DTS:X formats are now readily available and yet — as was the case with 5.1 surround broadcast — most consumers are reluctant to add more loudspeakers to their living room to experience immersive, periphonic (with-height) audio. Some of this reluctance is now being offset by improved living room-friendly loudspeaker solutions with the latest soundbar technologies and up-firing loudspeakers making immersive audio feasible to many more people.

WHAT CAN VIEWERS GAIN FROM NGA?

The focus thus far has been to get immersive formats into the home, and the benefits so far are a premium listening experience where the appropriate reproduction systems are available. There is undoubtedly a more engaging and exciting match-day experience to be had at home by adding height channels to the sound mix. It is an obvious development for sport — the Soundfield microphones in Premier League grounds have been capable of capturing height information for many years, it makes perfect sense not to throw away this additional audio information (as was the case until now) and anyone who has listened to football reproduced with height content will attest to the improved sonic experience of being fully immersed in the stadium atmosphere.

However periphonic reproduction is only scratching the surface of what is possible with NGA formats. Much more innovative improvements are likely to become available to the viewer at home as further potential is realised and when NGA workflows become more established.

Audio objects and personalisation: DR. BEN SHIRLEY describes a unique automated tool to extract audio event content and location.

CAN WE DO BETTER? OBJECT-BASED AUDIO AND PERSONALISATION

Dolby Atmos, MPEG-H and DTS:X are all, to a greater or lesser extent, examples of object-based audio (OBA) formats. As such they can carry multi-channel audio beds, based on 5.1, 7.1, 7.1+4 (and so on) loudspeaker channel configurations. Crucially these formats can also carry discrete audio objects which are intelligently added into the mix at the receiver or set top box (STB).

Audio objects facilitate one of the key benefits of object-based audio; that of personalisation based on user preferences or access needs. For the sports fan this could mean commentary that favours the home or away team, alternate languages, optional audio extras (such as the driver/pit communications in Formula 1) or a different sound balance — for example with enhanced speech for people with hearing loss or audio description for those with visual impairment. For now the objects in UK broadcast are limited to the commentary object and personalisation has yet to arrive in the home. Given that few viewers currently have the capability of reproducing height channels it seems likely that personalisation will be a key driver for consumers as it could be made available across any device from mobile phones to high-end STBs.

CHALLENGES OF NEXT-GENERATION AUDIO PRODUCTION FOR LIVE SPORT

The move from 5.1 channel-based audio broadcast to NGA broadcast is not without production challenges for broadcasters and the live production and outside broadcast industry has been working closely with companies such as Dolby and Fraunhofer to address these. Some are relatively straightforward integration challenges that occur as new technology is added to the outside broadcast facility or truck. Others are much more challenging. With current capture methods audio with a height component is already available at the OB truck and can be implemented via an appropriate encoder. However the more significant challenge of capturing dynamic and moving on-pitch audio, is less easily adapted to NGA. For example at a football match, the OB sound supervisor is constantly adjusting faders to try and ensure that the microphone nearest the rapidly moving ball is added into the mix to capture as many on-pitch sounds as possible. This on-pitch mix is panned to the centre channel so that it is locked to the screen, much like using centre channel for dialogue in film. Constantly chasing the ball with the faders in this manner requires considerable skill and reduces the time available to critically analyse and improve the overall sound balance. Even with the best sound supervisors many kicks are inaudible and the amount of crowd noise present in the pitch-side microphones has the effect of collapsing the crowd sound toward the centre channel. This is detrimental to the experience of being immersed in the crowd. These challenges were the main drivers for some recent developments in sports audio workflows that aim to facilitate (some of) the core benefits of NGA, and also to relieve busy sound supervisors from the time consuming and laborious manual work in "ball chasing" to allow them to focus on creating an amazing overall sound experience.
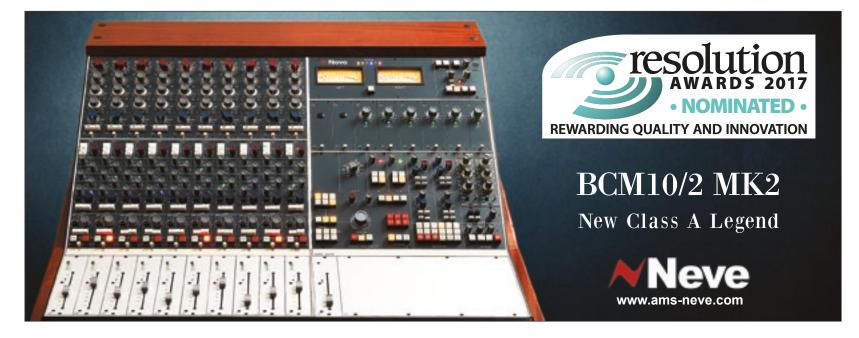
SALSA SOUND FOR NGA SPORTS BROADCAST

Traditionally, broadcast has been done in a channel-based, one-size-fits-all way which offers very little in terms of interaction or personalisation. It requires a new production output for every target reproduction system so is not a scalable solution. NGA / object-based audio, on the other hand, is very different: the whole audio scene is captured and all of the individual components — audio objects — can be retained throughout the broadcast chain with the final mix actually carried out at the STB. So far the lack of automated tools for managing audio objects is slowing NGA's development and, crucially, its uptake.

Salsa Sound's SF1, showcased at IBC 2017, solves many of these challenges and provides the sound supervisor at a football game with clean on-pitch sounds to a mixing console channel, or a stream of discrete short-term audio objects, tagged with locational and identifier metadata for future NGA advances, all without any need for additional tracking technologies — only the existing microphones are used. Salsa Sound's patented technology works natively in an object-based format and is ideally suited to prepare broadcasters for next-generation broadcast.

With Salsa Sound's SF1 we are specifically addressing an on-going, and until now, unsolved, challenge faced by object-based formats such as Atmos, MPEG-H and DTS:X. Recent automation solutions are more aimed at automated

control of on-pitch sounds for the sound supervisor. With Salsa's technology we aim to bring a premier sound experience to all viewers, not just those with high-end immersive audio systems at home.

Salsa's technology also accurately identifies the location and timing of on-field sounds producing a real time data stream locating key events. This can help assist semantic analysis of the match to help replay, highlight creation and match analysis, removing the need for manual event logging. Salsa can be optimised for other developing formats: for example, clean on-field sounds tagged with coordinate location data, can facilitate interactive VR and 360 video with augmented and immersive audio accurately reflecting the location of key sound events on the field of play.

Salsa's technology for audio and real time data is currently optimised for football, but extends to other live sports where there are specific on-field sounds that need to be captured and separated out as objects. Salsa Sound's SF1 was showcased at IBC 2017 and we carried out a live pilot test at a Premier League match in September to calibrate the system in readiness for integration with outside broadcast trucks over the coming months.

Accurate spatial positioning, automated mixing, augmented and object-based audio all from existing microphone feeds: Salsa is redefining what is possible in live sports audio. ■

mixing rather than audio-object extraction; the object-based paradigm requires new approaches to the live audio production workflow. Until now there have been no automated tools to extract audio event content and location. Salsa's technology seeks to go further: rather than just creating an automated mix and using this as an object, it extracts individual sounds to create a stream of discrete objects, which can be manipulated and processed individually, or treated as a continuous object-stream dependent on the application.

Key to Salsa's technology is an algorithm which "listens" to the audio and compares the incoming signal to a set of predefined acoustic feature templates, these templates define all the types of objects that we want to capture. For football these templates are for the sounds of a ball kick or a referee's whistle-blow, different sports require other templates to identify their key sound events. When a corresponding audio event is found the SF1 can either add the microphone signal to the mix or, based on the acoustic features of the detected event, can enhance it with pre-produced content. For football the end result is many more audible ball kicks and complete

standard pitch-side microphone feeds

clean on-pitch mix + real-time location metadata

Channel or object-based on-field sound mix

Who is Salsa Sound?

Dr Ben Shirley is co-founder of Salsa Sound Ltd, developing live sports audio broadcast solutions. Salsa Sound are a spin-out company implementing research carried out at University of Salford's Acoustics Research Centre in the UK. Ben is also a Senior Lecturer in Audio Technology at University of Salford where he carries out research in broadcast and object-based audio and broadcast accessibility.

In February 2017 the Salsa project won the backing of the Royal Academy of Engineering, with co-creator Dr Rob Oldfield awarded a prestigious Enterprise Fellowship to support the work, which the Academy called: 'a winning combination of academic excellence and business acumen'. The award gave Salsa Sound some of the resources to take Salsa from hardware prototype to broadcast-ready product.

Salsa's core algorithm for locating on-pitch sounds from a football game came out of the 3.5 year EU-funded research project FascinatE.

The FascinatE project involved a group of 11 partners from across Europe. FascinatE stands for: Format-Agnostic SCript-based INterAcTive Experience, and looked at broadcasting live events to give the viewer a more interactive experience, no matter what device they were using to the view the broadcast. On the FascinatE project, University of Salford's Acoustics Research Centre was responsible for much of the audio development work, especially audio capture from live events. In order to create a truly interactive experience for viewers, an object-based audio approach to the work was adopted. Extracting audio objects from a complex sound scene at a football game proved something of a challenge, one that two of the FascinatE team — Ben Shirley and Rob Oldfield — continued to work on after the FascinatE project completed in 2013.

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