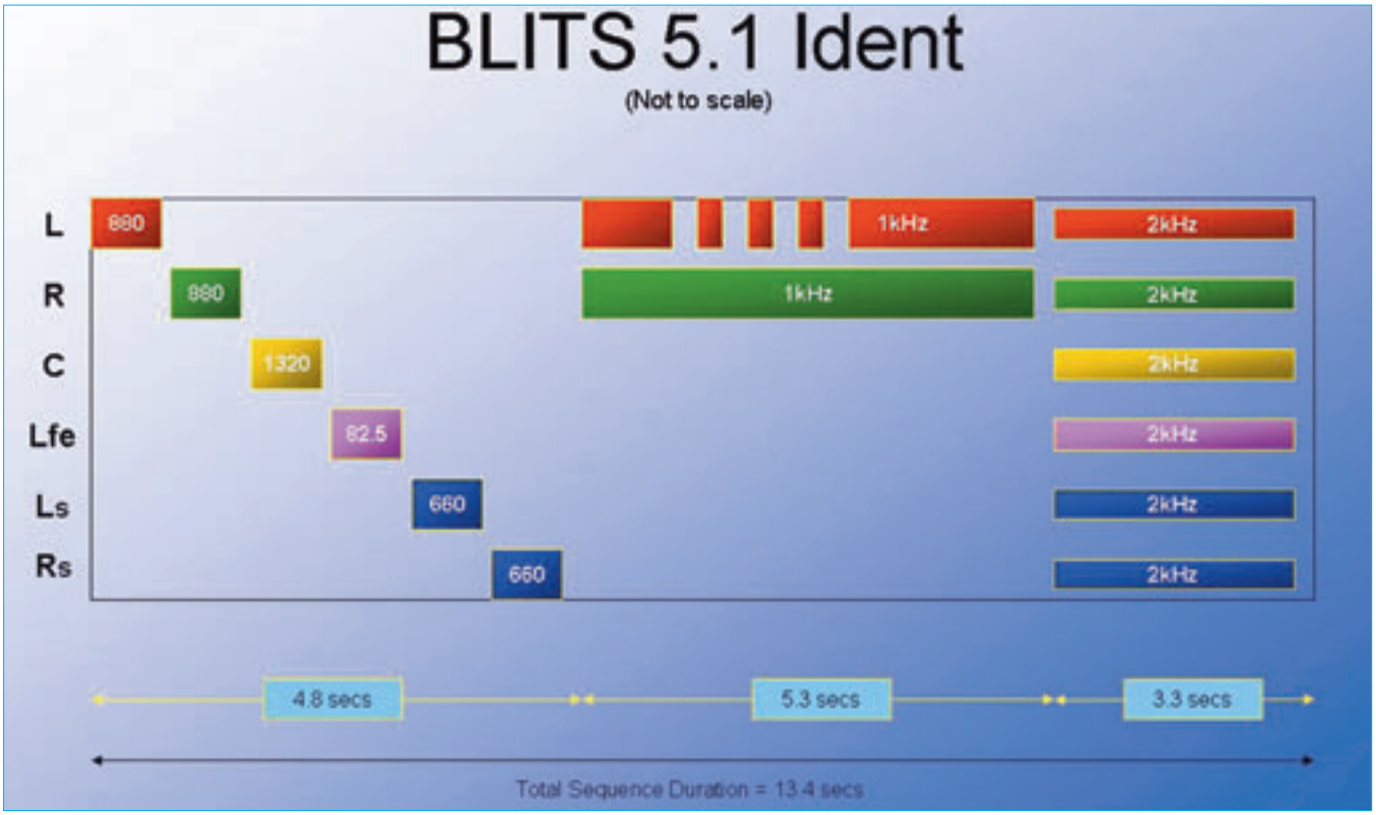

BLITS Surround Sound Ident

Martin Black MIBS, Senior Sound Supervisor at SKY TV describes an ingenious surround sound ident tone system.

It was in Autumn 2004 when Keith Lane and I – both Senior Sound Supervisors at Sky Television – began to plan the implementation of 5.1 surround sound for Sky Sports' imminent live HDTV service. One of the many and varied requirements which we identified early on in the project was a method of lining up audio feeds in 5.1. It needed to be quick and simple to use and interpret, but effective and foolproof at the same time. Of course, it wasn't going to be quite that simple.

Sky needed to derive a stereo Lt/Rt down-mix from the 5.1 to provide the audio to accompany the simultaneous SD transmissions. This was to be achieved using Dolby DP563 Prologic encoders alongside the DP571 Dolby E encoders. So the ident format we devised would also need to work when folded down in this way, so as to make sense when only the stereo version is being monitored.

Stereo – The Legacy

It was back in the early 1980s that TV sound began its uncharted journey into the world of stereo sound. The standard line-up signal in general use for stereo broadcasting in the UK at that time was the EBU R49[1] stereo ident – the familiar 1kHz tone, in-phase on both legs, with a single break of 250ms every three seconds on the left leg. Coming from the mono days, the breaks on the left leg were intended to flag that a right leg should also exist – and that perhaps the operator would we well advised to seek out the other half of the stereo signal!

Subsequently, Graham Haines MIBS, one of BBC TV OBs' Senior Sound Supervisors, had an idea for an alternative, and the result became known as 'GLITS': Graham's Line up Ident Tone System. This differed from the EBU version in that the single break on the left leg was followed by two similar breaks on the right, and the arrangement offered several technical advantages. Both versions have been in regular use in UK broadcasting ever since.

The introduction of stereo sound to TV also served to intensify one of the longest running 'differences of opinion' within the industry: that of the M-3 versus M-6 debate. The terms 'fold-down' and 'down-mix' are heard a great deal in connection with surround sound, but they're also applicable to the action of summing the left and right legs of a stereo signal to create a mono fold-down. An understanding of this is fundamental to understanding the issues concerning a 5.1 ident – but rather than

interrupt the flow here, this subject is discussed in the M-3:M-6 sidebar below.

Problems with EBU Tech-3304

We identified three potential problems with the only relevant and current EBU document on this topic, the EBU Tech-3304 (2005) *Multichannel Audio Line-up Tone.*[2]

1. Fold-down. In the same way that adding in-phase left and right stereo legs results in a 6dB level increase, so the issue of adding together (down-mixing) up to six legs of a 5.1 signal needs careful consideration to avoid a potentially very large resultant level increase with the stereo (and mono) fold-downs.

M-3:M-6

The in-phase electrical addition of two identical audio signals (say 1kHz at 0dBu) will result in a voltage which is 6dB greater (voltage addition). Therefore, to avoid over-modulating a mono output when using a signal derived in this way, and without changing the dynamic range, some fixed attenuation needs to be introduced – but how much?

The music purists argued that 6dB would be too much, since the two legs of a normal stereo programme aren't identical – the channels are not completely coherent as there is a distribution of energy across the stereo soundstage. Thus a compromise figure of –3dB was argued for – and adopted – by the BBC, and the resulting 'Summed Mono minus 3dB' became abbreviated to simply 'M-3'.

However, the problem with M-3 is that when any signal which produces a (phantom) central image is involved, the derived mono will be 3dB higher than either channel. That means that each channel can only be allowed to peak to +5dBu (PPM5.75), instead of +8dBu (PPM6).

To avoid this, an attenuation figure of –6dB is necessary – the 'M-6' format – and this produces a mono down-mix at the same level as the individual left and right legs whenever the source is equal in level and phase on both legs of the stereo. In other words when it's mono and centrally panned, which is arguably the case for the majority of in-vision speech on TV.

So M-6 was the method adopted by ITV and later by Sky, and is now the norm within the UK TV industry, as well in most other parts of the World. Even the BBC has finally followed suit in its television departments!

The EBU Tech-3304 sequence (see figure 1) was not considered to be suitable for Sky's requirements as it starts with 1kHz zero-level in-phase tone simultaneously on the five main legs, along with 80Hz on the LFE channel. It is worth noting, incidentally, that most 5.1-capable sound desks do a similar thing when tone-to-line is selected to a 5.1 output, so beware! Depending on the coefficients set in the fold-down matrix, the resultant 'stereo' down-mix could have the tones of the other four legs (C, LFE, Ls, Rs) added to the front L and R with little or no attenuation. This is clearly going to result in the stereo fold-down being at an undesirably high level.

2. Identing the individual channels. EBU Tech-3304 uses the same 1kHz tone to ident each of the legs. However, a steady single frequency tone is notoriously poor at providing directional clues to the ear. Arguably of more importance, Tech-3304 does not ident the legs in the order specified for broadcasting, but instead uses the older Film standard (EBU Tech R48).

On the face of it this might appear to be more useful when listening to the ident sequence on a 5.1 speaker system, as it cycles through the speakers sequentially in a clockwise direction. That's fine until you see it on a surround-capable bargraph-type meter where it jumps around confusingly rather than being sequentially left to right across the channels of the meter's display.

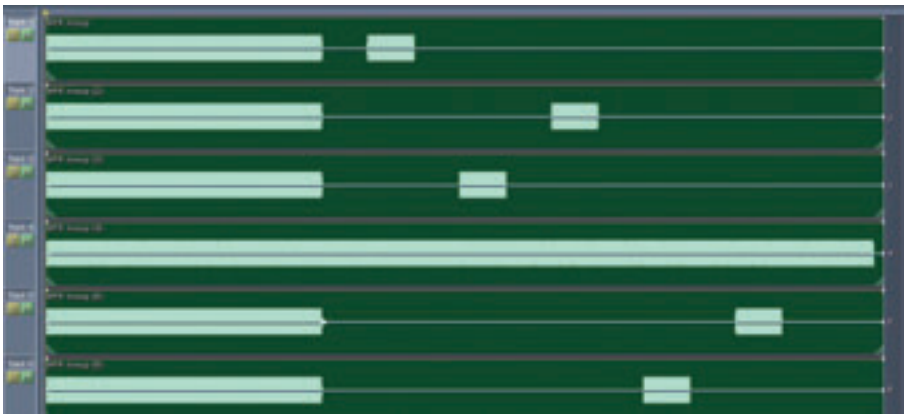

Figure 1: Adobe Audition screen showing the EBU Tech 3304 ident tone. Track order (top to bottom) is: L, R, C, LFE, Ls, Rs

However, it was thought necessary to have an identical signal on all legs simultaneously at some point in the sequence, if only to provide a phase-check capability. The BLITS – Black and Lane Ident Tone System – format that we devised achieves this in the third section of the sequence – a 2kHz tone at -6dBu (-24dBFS) is provided on all legs, the lower tone level ensuring no overmodulation of down-mixes.

To solve these two problems, BLITS was designed to use different frequency tones for the various channels, and the

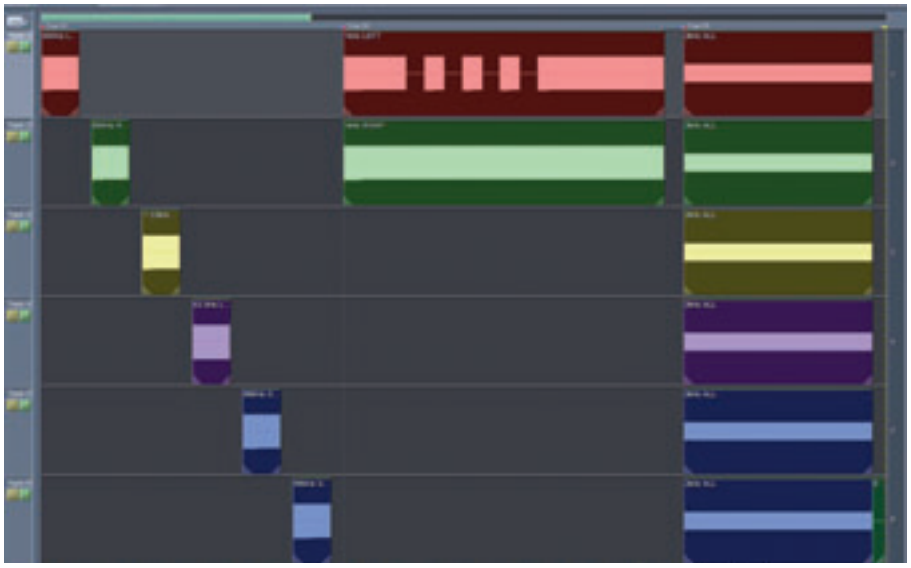

Figure 2: Adobe Audition screen showing the three sequence sections of the BLITS ident. Track order (top to bottom) is: L, R, C, LFE, Ls ,Rs

sequence order of tones matches that of the AES recommendation and current broadcast standards which makes much more sense on a visual display. The spatial sequence around the speakers also becomes familiar very quickly. This channel ident section is the first part of the BLITS sequence (see figure 2). The frequencies used are based on the international musical standard of 440Hz (A), and the interval of a perfect fifth above it (E). The actual frequencies are: L = 880Hz, R = 880Hz, C = 1320Hz, LFE = 82.5 Hz, Ls = 660Hz, and Rs = 660Hz. Note that the sequence replicates the order of signals in the three 'stereo' pairs which make up the 5.1 signal in the digital broadcast world.[3] [4]

3: Making it easy in stereo too. Let's not forget that, even if you have the time, staff, facilities and necessity to create a stereo mix which is completely separate from the 5.1 (not likely to be the case with many live transmissions), HD viewers will still receive a metadata-controlled down-mix of the 5.1 audio by virtue of the set-top box's stereo output being a fold-down mix. This is currently the case on all of Sky's HD platforms whenever an HD channel with 5.1 Dolby Digital sound is viewed with only stereo reproduction – such as when using a TV's stereo speakers fed via the STB's analogue SCART or digital HDMI output. So, even if a separate stereo mix is made by a broadcaster, it will not be heard by HD viewers listening in stereo.

Furthermore, on the Sky Sports platform a simultaneous Lt/Rt fold-down, created by a Dolby DP563 Prologic encoder, is used to deliver the stereo audio for the equivalent SD channel. The current Sky Sports stereo down-mix settings are for the Centre to be at -3dB, the LFE at 0dB and the surround channels to be -6dB.

So, the purpose of the middle section of the BLITS sequence, encoded on the left and right channels only, is to provide a 'familiar' signal to operators – particularly transmission operators – with no experience of surround sound. They will only get to monitor the stereo down-mix illustrated in figure 3. The first and last sections of the sequence may mean little to them, but the middle '1kHz tone on L & R' is intended to strike a familiar chord.

The four breaks in the left leg were needed because this was the minimum number which would differentiate a mono

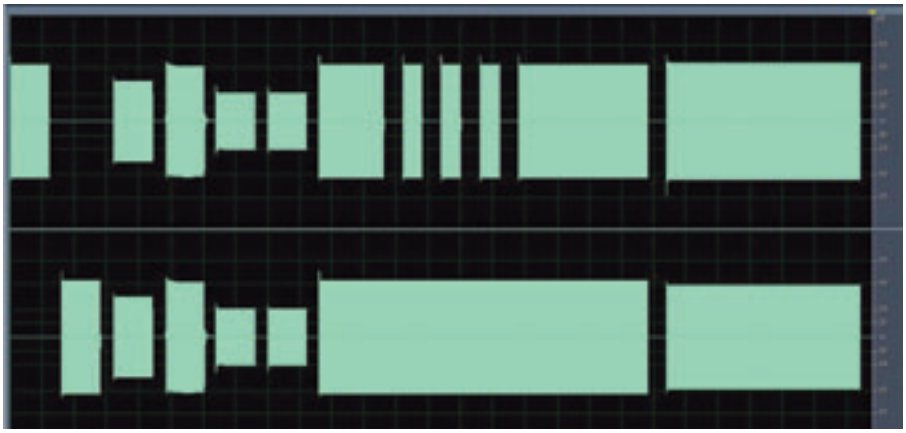

Figure 3: Adobe Audition screen showing the stereo fold-down of a 5.1 BLITS sequence using a Dolby DP563 ProLogic encoder. (NB. The vertical scale has been expanded for clarity).

BLITS down-mix from a EBU or GLITS tone down-mixes. Summed mono EBU (R49) tone produces a single level-dip while summed mono GLITS produces three level-dips – so BLITS produces four dips. This also acts as another flag to the operator that the mix originated in 5.1.

To aid in gauging the relative levels in figure 3, the middle 'stereo ident' section is at 0dBu, since it is not changed by the down-mix process. It can be seen from this that the third, 'phase-check', section also folds down to around zero-level – which is just what we wanted!

The fold-down level information is also programmed into the Dolby-E metadata, and thence in the Dolby Digital metadata sent to the consumer. This is what the domestic set-top box uses to create its stereo output for HD viewers without surround systems.

In Use

The almost daily use of the BLITS Ident in Sky Sports HD/5.1 transmissions has proved to be a great success, and its usability and diagnostic performance have exceeded expectations. It is regularly used for OB line-up with MCR and studios, OB and studio line-up with transmission suites, OB and studio line-up with VTR and EVS machines, and studio line-up of reverse circuits with MCR and OB units. Oh, and a slight variant of it was also used by Robert Edwards and Ian Rosam for all 5.1 surround line ups during the 2006 World Cup in Germany.

BLITS is also in almost daily use on over a dozen OB units in the UK to date, as well as in Sky's HD studios and MCR, and a commercially manufactured tone generator is available from CTP systems in Kent.[5] (See figure 4). Around twenty of these units are already in use in the UK, and in addition to its analogue and digital BLITS outputs, the CTP unit also provides a standard EBU R49 stereo ident on front left and right channels as a switchable alternative, controlled from the front panel or via GPI (with tallies). A simultaneous, permanent EBU stereo output is also provided separately.

The BLITS test sequence is also available as a 5.1 multichannel wave file from the author (contact martin.black@bskyb.com). The file size is about 2MB zipped and a 5.1 sound card is obviously required to reproduce it correctly – a stereo-only card will generally only play back the front left and right channels. Its copyright status is similar to shareware – it is licence-free to use, provided it's kept in its original form.

jbs

References

[1] EBU Recommendation R49-1999: *Tape alignment leader for the exchange of television programmes.*

[2] EBU Tech-3304: *Multichannel Audio Line-up Tone*

[3] EBU Technical Recommendation R91-2004: *Track allocations and recording levels for the exchange of multichannel audio signals*

[4] EBU Technical Recommendation R48-2005: *Allocation of audio tracks on digital television recorders*

[5] CTP Systems: www.ctpsystems.co.uk

Figure 4: CTP Systems' BLITS Generator