# POSITIVELY THE LAST WORD ON DMX

## Tony Gottelier introduces Charlie Paton David Bertenshaw and Marco Van Beek

Even amongst vested interests, the response to my earlier plea for people to respond to the call for opinion on the way forward for monitoring, or establishing, standards for industry protocols has been positively deafening.

Never mind, I am sure this means that as usual everyone expects that somebody else will do it for them. But as Steve Terry pointed out so eloquently in the last issue L+SI, this will not happen again in the way it did with DMX. Time is money, DMX cost the industry nothing but has generated lots of revenue for many firms. This time around there will be owt for nowt, but if we are to avoid chaos, something has to be organised.

USITT have finally, and probably on balance wisely, slammed the door on future expansion of the 512 protocol, in view of the risk of diminishing its inter-connectability. They are leaving it to individuals to work out their own salvation. This, in itself, presents an opportunity, for if there is a latent demand for enhancement somebody, somewhere, should at least be overseeing the situation before anarchy breaks out.

USITT also decided to take a structured and much more aggressive attitude to the matter of standards and, in particular, the advanced standard that everyone (with the possible exception of Pulsar's Paul Mardon) agrees is required. This will include serious evaluation of Strand's SMX contender.

All of this convinces me beyond all doubt that PLASA should urgently set up their own protocols committee, which I advocated after LDI, to act as the watchdog on behalf of UK manufacturers, if nothing else. In fact, of course, I would like to see it going a great deal further than that.

They should recommend a delegate to monitor USITT committee deliberations. They should carry out their own evaluations of both existing and future protocols, including consideration of the pressures for expansions and formulate consensus solutions. As with safety, they should publish regular bulletins to those interested members and, as important, to all outside interests abroad. They might also delegate an ambassador to make the necessary representations both here and overseas. The latter may well turn out to be a head-banging role on occasions.

All of this may well cost money but I believe it could, and should, be funded. After all as Steve Terry said, " . . there must be new corporate awareness that participation in a standards effort is both prestigious and commercially intelligent. By supporting standards work . . ., a company establishes itself as an industry leader and a meaningful contributor to a project which will eventually have good commercial fallout."

I would suggest that this committee's work could be funded in several ways. Accepting that it would be unfair that non-lighting control manufacturers should be expected to participate, a voluntary surcharge could be applied to the membership fees of those who are taking part. The protocols could subsequently be licensed with one rate for the participants and another, higher rate for non-participants. Special fees could enable overseas companies to participate also, as their input will prove essential to the universal acceptance of any proposals, and they should have subsequent access to the protocols through the higher rate license fee. Reciprocal arrangements could be made over these fees with other bodies abroad such as USITT. Alternatively, or as well, sponsorship for specific projects, or borrowed engineer's time, could be sought by the committee.

If we don't act now in a positive fashion, and we don't get the standards we want in the future, we will only have ourselves to blame. There have been plenty of groans about DMX, it was always intended as an expedient because the dedicated people who put it together were working without any funding whatsoever. That is not to say that it hasn't been hugely successful, it has, but if you don't want the next set of protocols wished on you in a similar fashion, now is the time to stand up and say so.

**To help with your deliberations, L+SI has gathered together a few relevant pieces received over the past few weeks. These include a background briefing on SMX from Charlie Paton of Light Works, the designers of the PALS system for Strand and instigators of their new protocol; an explanation and vindication of SMX version 2 by Strand's R&D director, Dave Bertenshaw; and a controversial extended argument against integration, and by implication therefore, against standardisation at all, from Marco Van Beek, technical operations manager for Vari-Lite Europe. (Do I hear you saying, "He would say that wouldn't he?" One wonders if there's any hope that Vari-Lite might one day offer their advanced protocol to the industry, via the USITT committee, as an alternative contender to SMX. I hope so, because I cannot believe that this would not solve problems for them and their clients also.)**

## SMX: A GUIDE FOR THE PERPLEXED

### Charlie Paton, director of Light Works Limited argues that what is good for the manufacturers is not always good for the market

Imagine a lighting installation of the not too distant future. Let's keep it simple, say a lecture theatre or small club. It might have the following equipment:

house lights
motorised curtain/screen
six motorised lights and colour changers
12 static lights and colour changers
six slide projectors
three video projectors
24 dimmer channels
six relays for effects etc.

To control this modest arrangement would at present require at least six separate, incompatible systems and the installed cost of the controls would certainly exceed that of the equipment it was controlling. In addition the operator, assuming there was only one, would need very long arms.

If a specifier wanted to future-proof the installation, with provision for more equipment to be added at a later date, he would have to make some expensive compromises by over-specifying potentially redundant facilities.

If we scale up our hypothetical installation to the size of, say, an opera house or TV studio, then the problems of incompatibility grow in direct proportion to the quantity of equipment controlled.

So what is the problem? Could it have something to do with protocols? Well, yes it could.

Now for the background. When Light Works first started the development of the PALS (Precision Automated Lighting System) back in 1986, we concluded, both from our earlier developments and looking around at available systems that a 'building block' approach was required, such that any light, from a humble pinspot to a 5kW fresnel, could be assembled from the same kit of hardware and software components. In addition, the system should be expandable without incurring a cost penalty. This required that the control should be capable of cueing from two to several hundred lights simultaneously.

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This is a demanding task. A PALS unit has four functions; pan, tilt, focus and colour. A single cue command comprises: address, positions, time and check. Positions are resolved to one part in a thousand. This necessitates sending considerably more data than that required by a dimmer, which at most, is resolved to one part in 256.

An investigation into available protocols was depressing. MIDI, an early contender, and valuable, would have made the job equivalent to printing a Sunday paper on bus tickets. DMX512, another contender, would have made the task like trying to print a Sunday paper on Monday with half the alphabet missing. Commercial networks were, and still are, too expensive to consider. Light Works decided to analyse the problem and develop a protocol from scratch.

The solution worked, and still works, but has its limitations. When we licensed the PALS system to Strand Lighting in 1988, they discovered to their dismay that they had absorbed yet another, to add to their growing stock of incompatible protocols. To their credit, they confronted the problem head-on and commissioned us to write a demonstration SMX. The working version was demonstrated to the USITT in 1989. After a period of further refinement and testing, SMX was published last year and is licensed free to interested parties.

Just as we are all grateful to the manufacturers of fax machines for agreeing to make them compatible and not based on telex, so I believe we should thank Strand Lighting for developing and publishing a workable protocol that enables compatibility and almost infinite expansion.

**"SMX does have shortfalls that need to be addressed"**

SMX does have shortfalls that need to be addressed. The protocol is almost entirely software driven. This requires a significant commitment in time to implement. There are gaps: no implementation for the control of audio visual equipment, or special effects, has yet been written (watch this space).

If manufacturers of competing systems feel unhappy at the thought of changing control software to SMX, they can demonstrate and publish their alternatives. In the absence of other viable 'future proof' options, what about providing the solutions required by the market with the devil we know?

## WHY SMX VERSION 2?

**David Bertenshaw, head of R&D at Strand explains**

The honest answer lies in having to implement it in a production version and develop test-software to exercise and prove the protocol. Certainly when SMX was launched at USITT in 1989, it was demonstrated working in a first prototype version. However, that was only experimental and as we progressed into developing the formal software specifications (such as state tables etc) it became clear that there remained several problems, such as possibilities for deadlocks between stations. Thus some changes to the basic structure became inevitable.

Simultaneously, there was some industry input in terms of suggestions for change and improvement. This was considered and married with internal (to Strand) comments and ideas, which were adopted where these seemed to be of real benefit, being mainly simplifications.

The changes started with the realisation that in version 1, RNR message which replaced data could lead to blockages, and perhaps a deadlock between stations. Thus we changed it to a control bit, allowing flow control simultaneous with data. The previous complexity of the adressing was simplified to a fixed two octet address and slave-slave functionality removed (we expect to provide for it later as a 'tandem' function in the master station) eliminating the second address.

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Since the network layer really only provided group address manipulation, this was deleted, and group addresses plus various other administrative functions put into a new management layer together with a comprehensive error coding system. It should be noted that ISO has also adopted the concept of a vertical management layer for OSI to resolve the problem of co-ordinating the whole structure.

The presentation layer was renamed 'Application Layer' since it doesn't change the data, only defining the application format of the data which the SMX transport system handles transparently. Finally, the maximum frame length was increased to a more useful 255 octets and the checksum changed to a 16 bit system. The latter was because, after the study, we realised that a simple 8 bit checksum was insufficiently robust, especially against false 9th bits (the framing bit). An error here means that the checksum is a random data octet, having a 1 in 256 chance of being right, which we felt was too risky. Thus we changed to the 16 bit FCS checksum used by the ISO for file record checking. We had considered using a proper CRC, but software calculation of these can be quite time consuming, especially on 8 bit processors, and the chosen FCS has a high degree of convolution and is thus almost as immune as a CRC to systematic errors.

We kept an eye on the USITT-IES/TTFL committee movements, however, the lack of any initiative there seemed to indicate that the only industry feedback was going to be the ad hoc input already received. Since there was no coherent body to consult with, we felt we might just as well announce version 2, once we had got the bugs out of it and proven it in product, which was achieved by LDI 90. The current documents (part 1) cover the layers up to transport. We have dimmer level and supervisory applications working, but not published yet and we have to complete the automated luminaire application layer.

At the USITT 91 conference in Boston, there were two relevant sessions. The first was an attempt to propose an advanced DMX protocol, particularly to provide 16 bit accuracy to eliminate dimmer stepping on digital dimmers. A practical demonstration was given of the effect on a dimmer using 8 bit values incrementing and decrementing. Whilst there was concern that the visible steps were a real problem, no one wanted any greater level accuracy than 8 bit. It was then pointed out that stepping can be caused both by slow console cycle times (medium speed fades can still have 2 or 3 bit fade steps) and dimmers responding fast enough to show the 1 bit changes. It was explained that with analogue multiplex dimmers this tendency is eliminated by the simple filtering of sample-and-hold capacitors thus, on modern digital dimmers a simple digital filter algorithm can smooth out small changes yet respond rapidly to large ones. Therefore, stepping on DMX512 input digital dimmers driven by a competent console, should be considered as a fault in the dimmer, not the protocol. This view was adopted.

The issue of SMX was then raised, and whilst there remained nervousness over its complexity, no one really had alternatives to offer (except for Show Control via MIDI) over the current use of DMX for uni-directional 8 bit control. At a later session which was supposed to be a report by the IES/TTFL committee on its deliberations on SMX it was reported that, in fact, they had not considered it (I'm not sure the committee ever met). Thus, a motion was moved and accepted that the issue be taken back to USITT again. Although it was accepted that a normal USITT committee stands no real chance of finding the resources to invent an SMX-like protocol. Nevertheless, there remained a majority who considered such a protocol desirable, though to be honest, the session at 8.30am was not very heavily attended (maybe 40-50 people). It was also pointed out that really only a major manufacturer was in a position to maintain a complex protocol such as this and, whilst a USITT body could certainly expect to oversee change and development, detailed maintenance and development would be beyond the usual ad hoc committee structure.

Therefore, it was proposed and agreed that USITT should study, and if thought fit, adopt SMX to be maintained by Strand. Steve Terry of Production Arts would manage the study, and it would consist of a mail shot review of all those who contributed to the DMX512 1990 update, plus any others who express an interest. Ian Ibbitson at Strand L.A. would provide administration and mailing services.

The goal is to complete a review and present a position paper, and perhaps even a motion to adopt, by LDI 91 in Reno. I can vouch for the fact that the review is starting, since I have recently received an invitation circular to join in from Steve Terry.

## THE VARI-LITE VIEW

### Marco Van Beek, technical operations manager for Vari-Lite Europe argues against downward compatibility

In our industry, just like any other industry, we are heavily pressurised by the market we serve. The people who pay the bills want more value for less money. This is basic business.

The companies who are good at it look at the long term effects of having a varied stock and decide on certain paths to follow which determine whether to buy or sub-hire, based on the feasibility of maintaining such equipment on shows and are, in effect, 'customers' themselves. They often offer better facilities to the client in order to keep a standard stock.

'Buy off the shelf' to suit the customer is a very short term view and in the end affects a company's ability to buy better equipment, which is what they need to be able to stay abreast of the competition.

Companies who serve the 'unique product' market have costs in different areas. A lot of money has to be put up-front in R&D and in this way, no restrictions of downward compatibility are necessary. So why limit one's design to an existing protocol which may be totally unsuitable and already out of date?

Every time new equipment comes out it offers more facilities. Why?, because designers also want more for your money. The only really innovative controllers come from these markets, because they are able to break out of the mould that downward compatibility otherwise pushes them into.

In terms of integration there are existing standards at both ends of the market range. Analogue works very well and is a very good building block. MIDI is also a long standing control system and can be adapted for lighting use at minimal cost. The 'in the middle' protocols, mainly DMX512, are multiplexing systems and should not be taken as anything else. Too much importance has been placed on a digital multiplexing system which is actually outdated.

DMX512's limitations are painfully visible in terms of speed and refresh rates and the lighting companies who base their designs around it have had to sacrifice flexibility to do so. A prime example of this is the Summa HTI unit. The internal resolution of the pan and tilt movements are far higher than anything DMX512 could drive; but that was the market they were aiming at, to comply with some companies urging to standardise on DMX512. And one can only control a limited number of them per desk. This is downward compatibility at its worst. (Editor's Note: The Summa HTI uses approximately 190,000 step resolution internally to control the motor. By co-opting a channel on DMX to set a speed for the movement, it is possible to send a position with an accuracy of 256 steps but to have the head move in steps of 0.0019 degrees, thus smoothing out the visible travel. Subsequently, by assigning two channels to each of Pan and Tilt, one for 'course' position and the other for 'fine' accuracy, Summa are able to claim 65,536 step resolution in practice.)

**"DMX512's limitations are painfully visible"**

The existence of 'proprietary' protocols for colour changers and automated lights should be, purely, to give designers what they have asked for and not to protect the 'short term' market.

As for connecting to other systems, the single controller for a lot of units approach is a very irresponsible method. The complexity of systems today is such that inevitably they will sometimes fail, whether due to a power failure or a can of beer! The objective must be damage limitation, and this can be best achieved by linking controllers, rather than slaving them totally. The use of MIDI between desks is a prime example of a good solution as each console is still operable in an emergency.

The idea of systems integration is at the forefront of the design strategy at Vari-Lite. We have seen the Vari*Lite system progress from a DMX512 style comms to a far more complex bi-directional link based on an existing military standard. We can link, via MIDI, to SMPTE time-code or sequencer and via 0-10vdc to conventional dimmers and scrollers. If this protocol capability were translated in conventional terms it would control over 15000 channels with a 50ms (micro second) refresh rate. Vari-Lite is not trying to protect its market but pushing way past the limitations of existing 'standards' into the 1990s. Why should manufacturers and equipment designers be limited by dated technology in the name of 'integration'?

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Certainly some research and development teams would benefit from better standardisation but, in an industry where the only real cable connector protocol is the 15A plug, no integrated system will be reached unless it is created by a single manufacturer and adopted world-wide. DMX512 is not the long term answer. It is limited, inflexible, slow and almost out of date. System integration exists already within the framework of a number of existing automated lighting manufacturers and it is likely that designers and operators will push conventional lighting companies towards these systems.

The single button approach allows operators and programmers to use the complexities of the console to the maximum and still see the show. That is why this will be the path forward and why, on the majority of large shows, there are several operators, because one person would not be able to address the concept of the show, design it and programme it, fully integrated or not. More and more designers rely heavily on operators to 'translate' their concepts into reality. This way the LD can stay objective and the operator can maximise the flexibility of the system.

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