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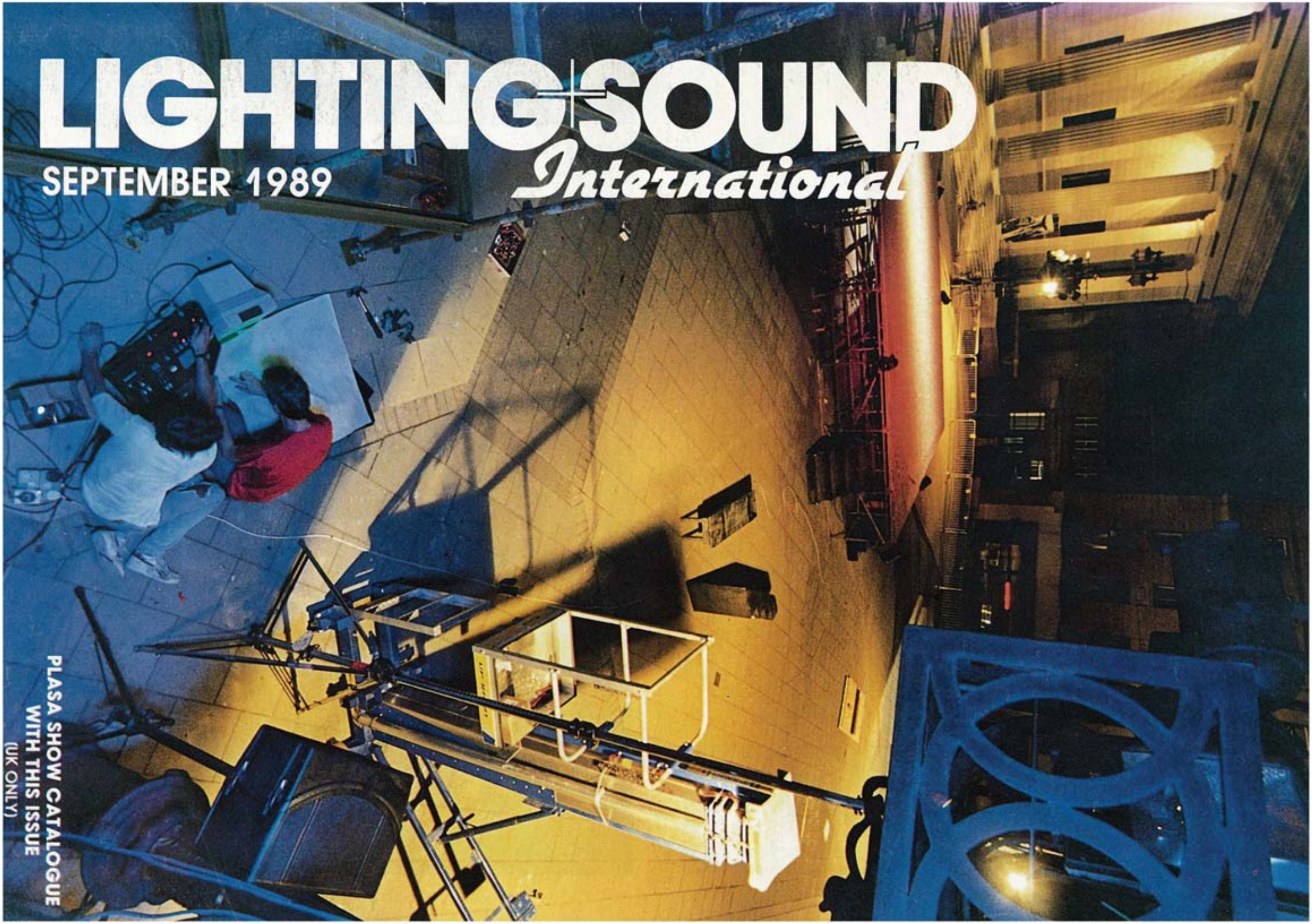


PLASA SHOW CATALOGUE WITH THIS ISSUE (UK ONLY)

SMX - A NEW OPEN STANDARD

David Bertenshaw

In last month's issue, Alan McGregor discussed the various problems and ultimate unsuitability of using DMX512 as a control protocol for automated lighting. This month Strand explore similar problems over a broader range of applications and describe their solution to communication protocols in the entertainment industry, with particular capability in automated luminaires control. David Bertenshaw of Strand UK explains the background and gives a technical overview of SMX, with a particularly enticing conclusion.

It is a widely held belief that a free market generates the greatest range of choice for its customers, usually to their benefit. This must surely be true of today's international theatre and television lighting market where the variety of choice is immense. However, this variety generates its own problems, and one such is the proliferation of different standards of signal interfaces on different pieces of electronic equipment. This is such that, even though two items of equipment may represent the ideal choice, that opportunity is denied since often the equipments cannot communicate. Thus the real choice may be limited and manufacturers may quite legitimately use custom interfaces to ensure that compatibility is restricted to only their range.

There have been moves to establish standards to eliminate this problem, such as the two USITT dimmer protocols, but this has not so far stretched to moving lights, console to console, smart dimmer communications, and other such applications. To illustrate the number of interfaces in use in a major entertainment complex, consider the possible installation shown on this page.

Strand Lighting, with its products and companies in Europe, USA and Australasia, concluded that its own internal market for products and systems was being similarly hindered by this problem. For example, Strand Lighting has three varieties of automated lighting control interfaces: the older M2-Bus, PALS-MRL and Showchangers. None of these is compatible, and whilst fully adequate for their products, lack adequate extensibility for future needs. Even this one problem was critical since, for example, there would be clear benefits to being able to mix PALS and Parscan luminaires on the same controlling console. Thus in 1988 Strand's three R&D centres concluded that a fresh approach was needed and a new communications standard should be developed for common use within the Strand group. The goals of the new standard were:

Economic and simple to implement.
Covers all current and foreseen needs plus allowance for unforeseen future expansion.
Based as far as possible on proven electronic industry standards.
Can be standardised across products.
Some physical compatiblity with existing standards, e.g. DMX512 to aid migration.
Uni or Bi-directional, secure communication.

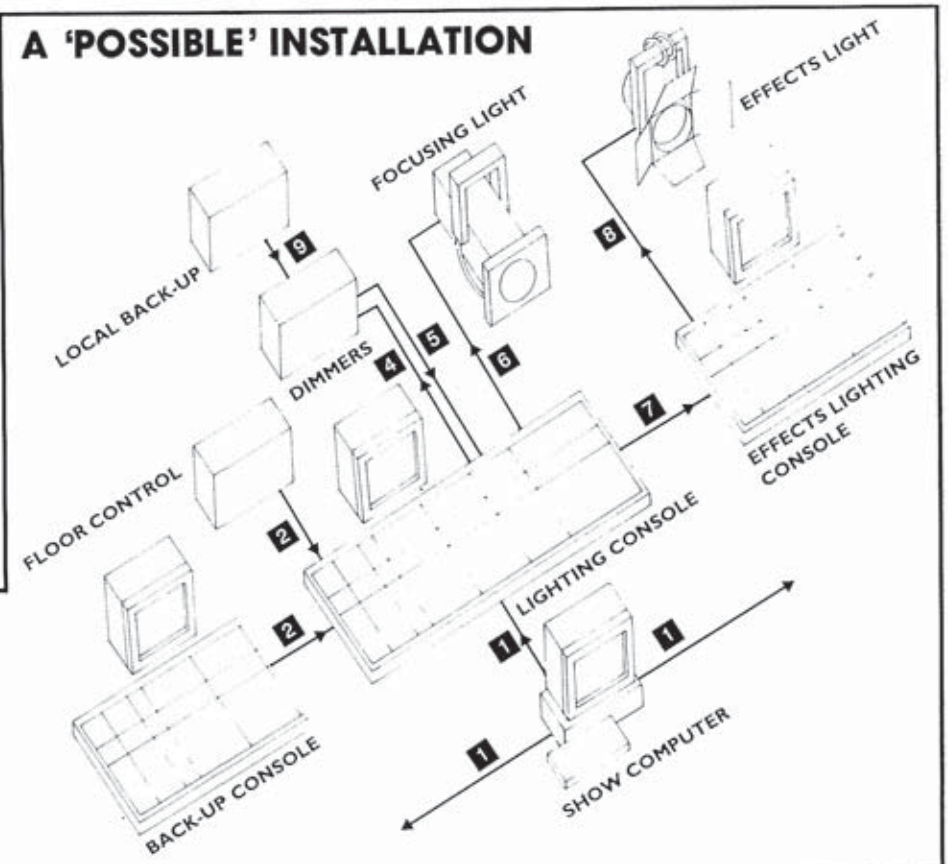
Strand is also party to a USITT (United States Institute of Theatre Technology) CCS committee considering future communication protocols, where decisions were reached in 1988 echoing Strand's own conclusions. This was that an all-embracing network in a major studio or theatre connecting every console to every dimmer to every moving light, would require data-rates from 10 to 100 MBaud (millions of data bits per second). Even with today's micro-electronic technology, this is likely to be an expensive and difficult goal to implement for some time. Thus it was concluded that the problem must be sub-divided into affordable components, such that a number of compatible interfaces of modest performance may be used together to achieve a full system. As an example, a dimmer system may be level controlled by a console on one communications link, with a second, perhaps slower link for supervisory and maintenance information. However, both links should use common standards and interfaces.

With this requirement, existing lighting and computer industry published standards were reviewed. From the lighting industry only DMX512 showed any promise and even here, if it had been extended to meet all the goals, it would have been a new standard anyway. In the computer industry however, there are very strong developments to provide common data communications protocols, to bring order to another market also suffering from incompatibility. This is exemplified by the ISO (International Standards Organisation) Open System Interconnection strategy. It describes a seven layer structure to data transmission separating the successful transfer of data from the interpretation of data, and has become an internationally accepted design method. No other industry models matched this clarity nor met the general goals of simplicity and economy of interface, so this became the preferred approach.

Whilst OSI met the structural needs, the detail standards were unfortunately much more complex than desired, still in the process of final definition, and only provided a point-to-point service via a packet network exchange. Therefore, for one station (e.g. console) to talk to several others, it would have to do so by connection through a central switch,like a telephone exchange. There was no provision for a bus structured system (1 transmitter directly to many receivers) except by use of the IEEE 802 series of interfaces, and in turn rather expensive. Thus it was concluded that a special purpose communications protocol had to be designed, based on the proven OSI model, but focused on the particular needs of the lighting industry.

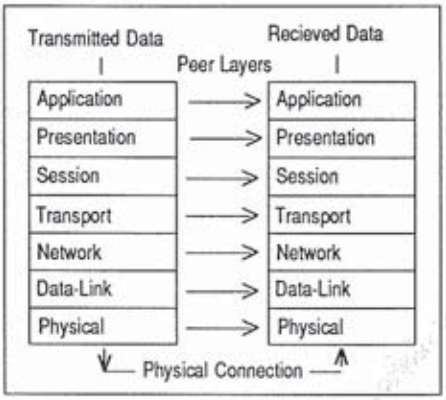
It is perhaps appropriate to give an overview of the OSI model to allow a better

A 'POSSIBLE' INSTALLATION



Purpose of Connection
(1) Synchronisation of separate show controls
(2) Transfer of Back-up data
(3) Commands from Floor control
(4) Dimmer Levels
(5) Dimmer Supervisory and Fault Detect
(6) Position data for precision refocusing lights
(7) Cue Synchronisation for Auxiliary Console
(8) Position data for Effects Automated Lighting
(9) Janitor local lighting control

understanding of what is meant. OSI provides for a pair of communicating computer programmes to exchange data by means of communicating peer functional layers. Each layer provides a facility to its higher layer and in conjunction with its communicating peer layer, provides a particular communications service for the data transaction.



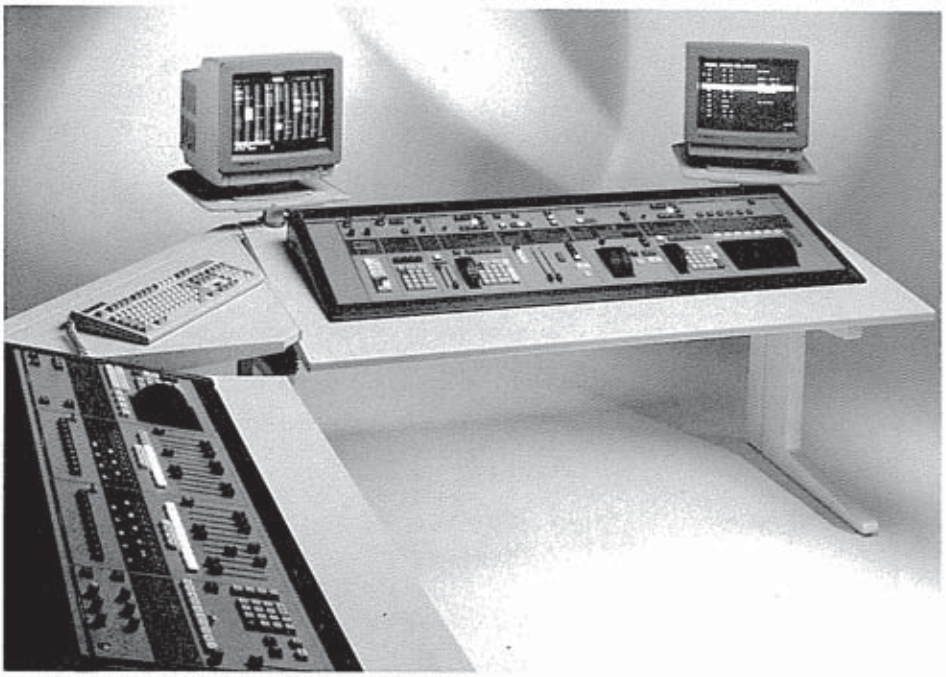
Thus for example, the two Transport layers provide a facility of reliable, error-free transmission of data from one Session layer to the other, utilising the services of the Network layers.

These layers have basic functions as given below:

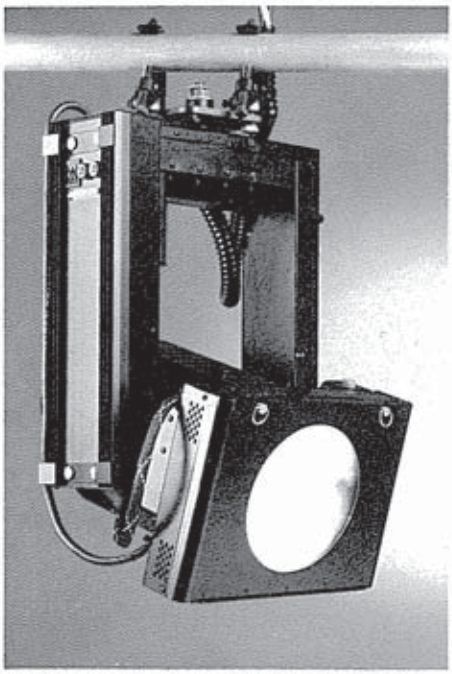
Layer		
7	Application	Final creator/user of data.
6	Presentation	Formats various application data into an appropriate standard format for universal understanding
5	Session	Control of multiple communications between same stations (not used on SMX)
4	Transport	Provides reliable, error free transport of data, recovers from errors and controls flow in case of congestion
3	Network	Provides, recognises and controls message flow to the correct physical addresses in network, and allows for groups
2	Data-Link	Formats all data from above layers into a standard packet structure and controls use of the physical data link
1	Physical	Conversion from logical to physical signals and connectors

Naturally something as complex as this took considerable development effort and had to be prototyped to prove the concepts culminating in the demonstration of full position control of a PALS automated luminaire at USITT in Calgary during April 1989. Using the new bi-directional protocol, SMX, a PALS PC controller was able to refocus and read back the precise position of the luminaire, even when changed by physical manual adjustment of the fixture. In addition, a special software programme showed the actual messages to and from the luminaire on the multiplexed data link, demonstrating the format, efficiency and flow of communications.

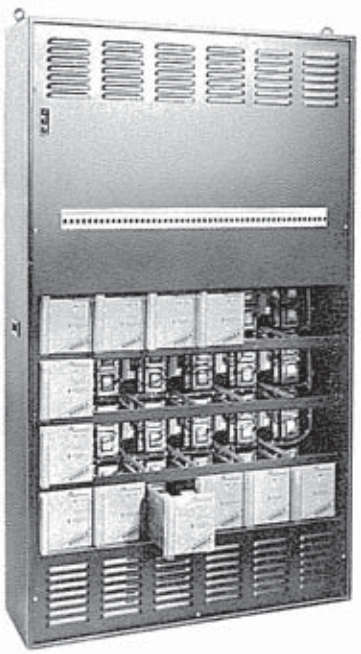
For Strand Lighting there are clear benefits from this approach, giving standardised, extensible interfaces, re-usable software across products and greater ease of equipment inter-connection, hence enabling efforts to be concentrated on providing better systems for its customers. The biggest step forward though was the accompanying announcement at USITT that Strand had removed its copyright notice and was making the SMX standard open for public use. It will take time for the developments to come to fruition,



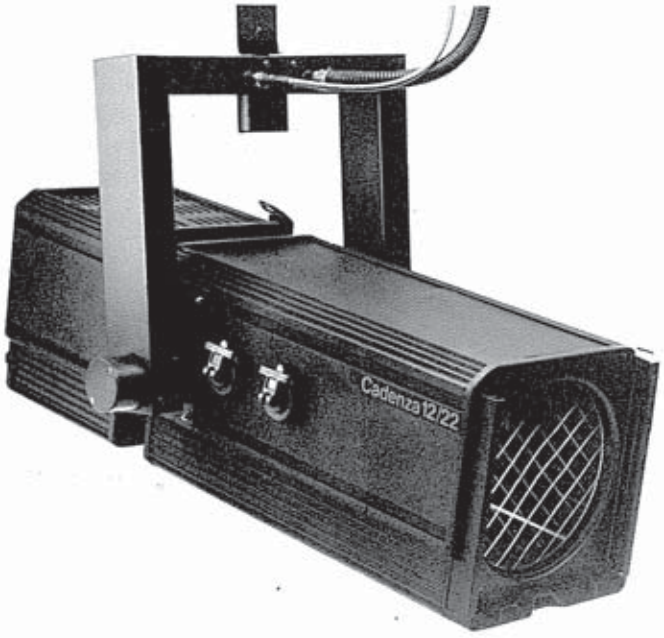
Strand's memory lighting control board Galaxy 3.



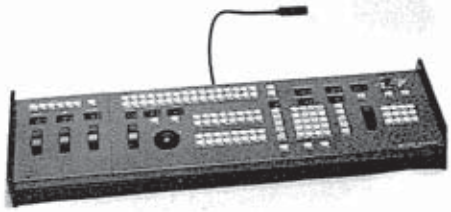
A PALS luminaire as used in Aspects of Love.



Strand's PIP (Plug-in Professional) dimmer bank.



PALS Cadenza 12/22 focusing light.



Strand's Taskmaster effects lighting console.

but the seeds are now sown for a new era of compatible choice available to the whole lighting industry. And yes, it does stand for Strand MultipleX.

I should like to acknowledge the considerable support given by the Vice Presidents of R&D, Jody Good in Strand Electro Controls, Salt Lake City and Joe Kuciera in Strand Lighting Inc., Los Angeles; together with the valuable work contributed by many engineers, particularly Peter Willis, Richard Farthing, Alastair Kitching, Steve Kleinline, Ken Donnell and Otto Leichliter.

For the more technically minded a brief review of SMX is given below. The structure is logically a token passing ring, to avoid contention, on a physical bus structure.

Layer

7 Application
The ultimate communicating microprocessor programme, normally the software programme in the processor based product. There is no requirement laid down.

6 Presentation
128 different 'data types' are provided, of which dimmer levels (8+16 bit) and times, file transfer; moving light parameters (64 varieties) and a communications supervisory are defined. In all data types, strict definition of data meanings is maintained.

5 Session
This is not used in SMX.

4 Transport
Data is transferred in numbered packets called I (Information) Frames and the transport layer checks sequencing, recovers from errors in sequence or time-out. It acknowledges I frames end to end, controls data flow, and manages each connection as made.
In addition I frames can be segmented and concatenated to transmit large data entities over the limited packet size.

3 Network
Manages physical addressing. Addressing range 0-127 or 0-32,511 in extended mode. 255 programmable groups are provided for, and an all stations broadcast group.

2 Data-Link
Data is formatted into packets as either an I Frame or Control Frame. I frames are numbered 0 or 1 and carry presentation data. The maximum packet length is 140 bytes, with byte count and longitudinal redundancy check character for error checking.
Data is transmitted as 8 bit asynchronous, with a 9th bit ("parity") used to signal packet start. All data values are valid. A Bus Token bit is circulated by a Bus master to control which station may and must transmit.

1 Physical
The connection is via RS485 on a two wire screened party bus. Transmission can be uni-directional or half-duplex bi-directional. Data rates may be 250/62.5/9.6/2.4K Baud. Connection via XLR 5 pin as per DMX512.

Bona-fide interested parties, requiring a copy of the SMX standard, should make application through their local Strand office to their relevant Head Office R&D Groups; Strand Lighting Ltd., London; Strand Lighting Inc., Los Angeles; or Strand Electro Controls, Salt Lake City.

The Document Reference is 3X32478.

David Bertenshaw B.Sc(Eng), AGGI, MIEE, C.Eng is director of R&D for Strand Lighting Ltd., London.

A graduate from Imperial College, London University in 1970, he completed an apprenticeship with G.E.C. (Telecommunications) and joined Rank Strand Electronics as a development engineer. Progression in Strand through to development engineering manager, encompassed design and management experience in controls, dimmers and luminaire development, he left in 1984 to gain alternate experience in the computer peripherals industry. He rejoined Strand in 1987 as director of international R&D for UK and USA.