

# MA Networking



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Keep IT simple!



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Genesis "Turn it on again"-World Tour



A Symphony of Lights, Hong Kong



Central Station Berlin, Opening 2006



# Networking by MA Lighting – the central nervous system

Today the installation of complex lighting systems is nearly impossible without a working network system. With the increasing requirements of clients and designers wanting to integrate new technologies such as LEDs and media servers, the need for a sophisticated solution for signal transportation is inevitable. Designers, decision makers, consultants and technicians in the branch of Entertainment do not want to miss these new trends in lighting technologies. MA Lighting and its partners offer a complete system with components that build a synergy which is absolutely unequalled on the market.

**But how does it fit together?**

The Ethernet based MA-Net protocols, the internal language of the system, is the solution that makes the system so powerful. The MA network is not just a bordered network. Furthermore it enables you to integrate other system components and to connect diverse control and protocol solutions.

This brochure gives you a good overview to better understand the MA network and the Entertainment network technologies of the future.

To find out more about the components of the MA system, please have a look at the MA main catalogue or [www.malighting.com](http://www.malighting.com)

## What is networking?

Networking can be compared with the human body where the lighting console shows up as the brain and the controllable components – the fixtures – are the arms and legs of the system. The network represents the nervous system. If one part of this system fails, the complete system might fail. As the human body consists of a multitude of nerves, the most essential parts in any network environment are switches, cables and connectors.

The User Protocol, e.g. MA-Net, is a special language which achieves the action – for example controlling a grandMA video. The action can be achieved with different protocols. It depends on the application and the components which protocol can be used and is the most appropriate.

Essentially, networking is nothing new for the Entertainment industry as everybody who has put a lighting rig together has already set up a DMX-Network.

Ethernet based networking is on its way and it would be narrow-minded to close oneself off from the possibilities of this technology presented in this brochure.

This Entertainment networking is not a half developed technology: it has already in practice proved itself in every segment of the market (Concert Touring / Live Events, Theatre / Musicals, TV / Studios, Architainment).

# DMX networks

Since 1986 DMX512 has been the standard protocol for controlling lighting equipment and related devices. DMX512 is a digital, serial asynchronous signal with an 8bit resolution which offers 256 steps per channel. Furthermore it is possible to send 512 8bit-channels, meaning one DMX-Universe, over one physical DMX-Cable.

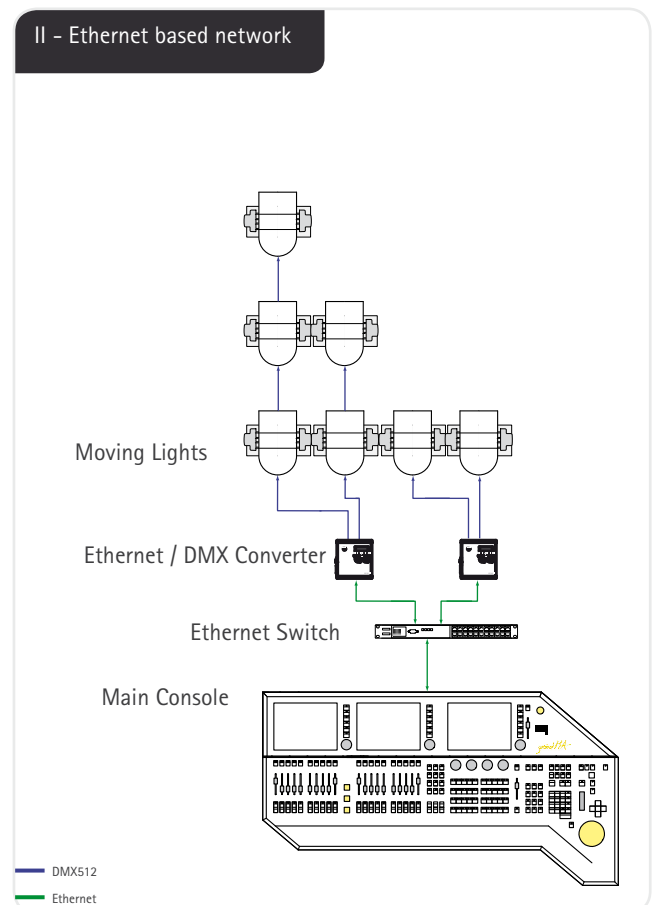
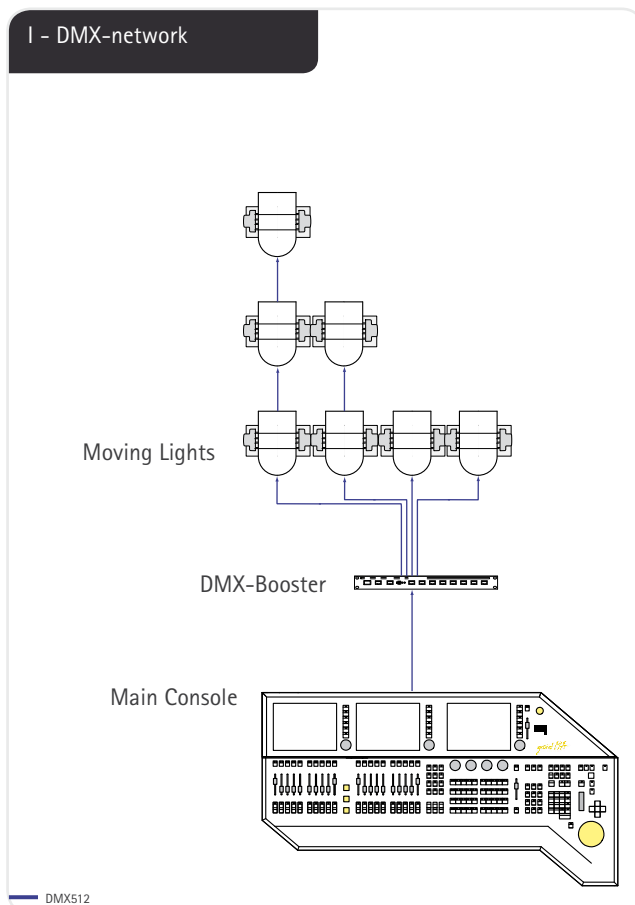
Originally designed for controlling conventional lights, DMX512 nowadays has reached the limit of possibilities and comfortable use. Of course DMX512 remains appropriate for some solutions as it is a standardized and fault-tolerant technology.

Therefore the grandMA consoles are DMX512-A (recent version) compatible and can be used in DMX stand-alone environments as seen in the drawing DMX-Network (I). With RDM it is possible to have a simple bidirectional data transmission in a DMX network.

The change from DMX512 to an Ethernet based network is nothing to be afraid of. Comparing drawing DMX-Network (I) with drawing Ethernet based network (II), one can see that the structural difference of both networks is not so big. The most common and easy application is transporting DMX over Ethernet.

## Key Features

- Fixed data transmission (250 kbit/s)
- Unidirectional data transmission
- Transmission of all data over just one cable - daisy chain wired
- Worldwide acceptance and availability of equipment
- General standardisation of cables and connectors



# Ethernet-based network

## Key Features

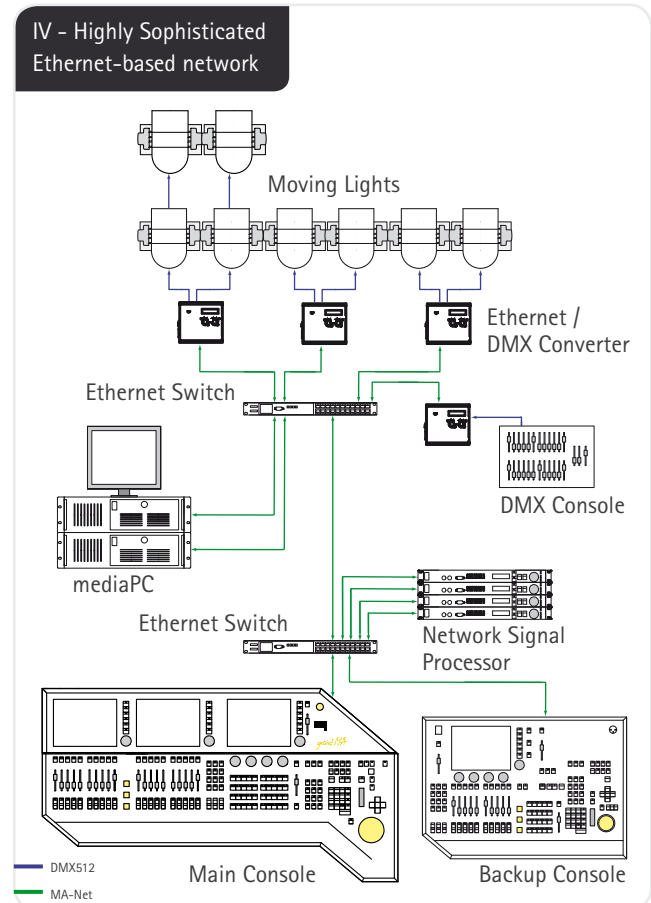
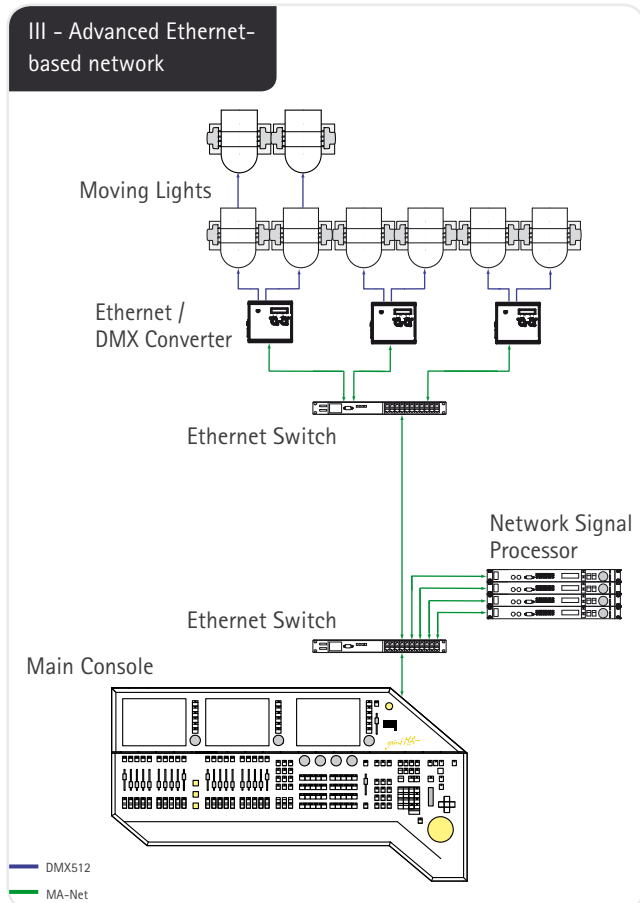
- Higher Bandwidth for more DMX universes and faster data transmission than DMX
- Bidirectional data transmission for backup solutions, multi-user sessions and feedback
- Transmission of all data over just one cable - star wired
- Worldwide acceptance and availability of equipment
- General standardisation of cables and connectors

Ethernet is a networking technology for local area networks (LAN) which defines wiring, encoding, frame structures and network accessing rules.

Therefore it provides the ideal platform for lighting data distribution and new features such as comfortable backup solutions, multi-user programming, equipment feedback, local data backup etc.

The standardised communication over a wide range of equipment - e.g. cable, connector, switches - and protocols - e.g. TCP/IP - creates the best environment for lighting control solutions. On one hand, the use of industrial components meets the ever increasing reliability and on the other hand it gives the possibility to support diverse control and protocol solutions.

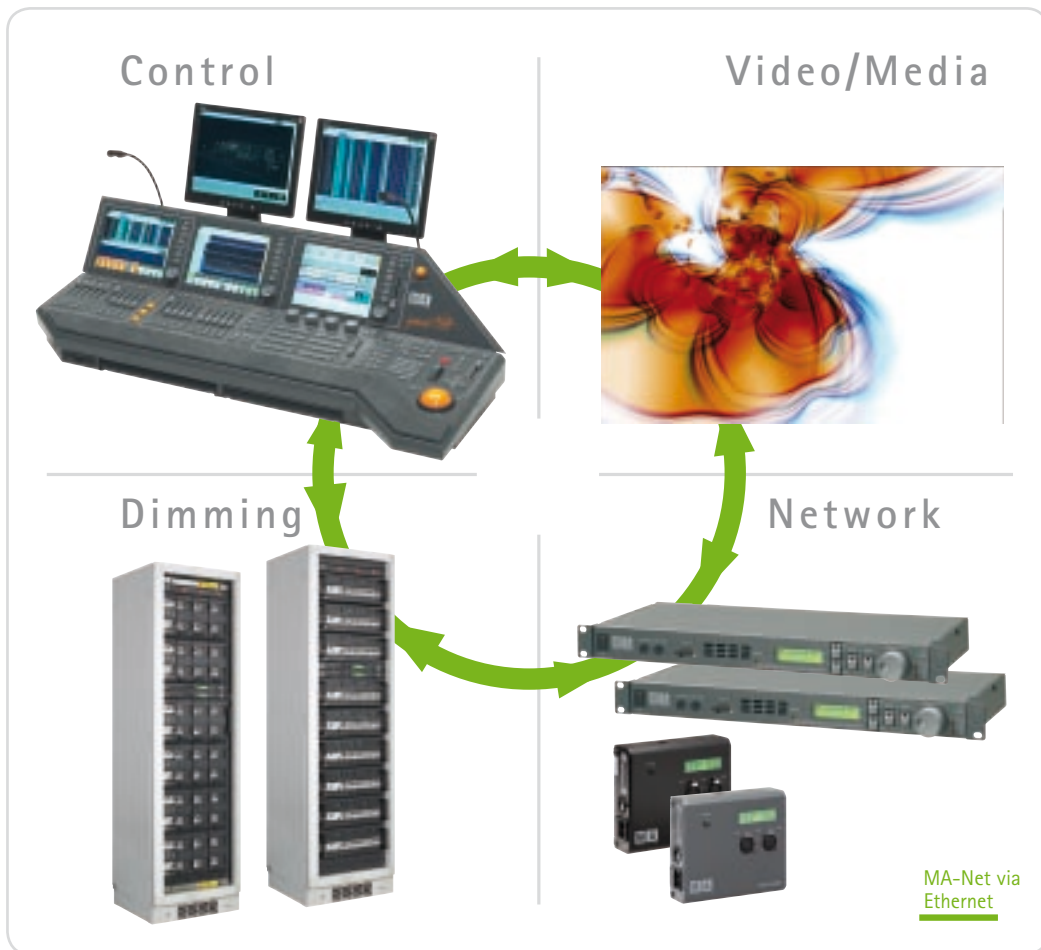
The drawings II, III and IV give examples of the possibilities of a MA networking system. Nearly every requirement for an entertainment project is realisable and can be solved with the new technologies.





# The MA System Solution

With the grandMA consoles, grandMA video, the Network Signal Processor (NSP) and the digital installation dimmer dimMA MA Lighting offers a fully integrated MA system that has unrivalled solutions for sophisticated projects with complex system requirements. All system components communicate via MA-Net in an Ethernet based network, so that the different types of signals do not need to run on different systems. (However, the components of the integrated MA system are also extremely powerful when used as stand-alone products each having their own direct DMX outputs.) Networking needs a new base of thinking and counting which is presented on the next pages.



# MA-Net

## The MA User Protocol

MA-Net is the internal system language and User Protocol which enables bidirectional communication with all hard- and software components of the MA-System.

### Key Features

- 100 Base-TX Ethernet (100MBit/s – Fast Ethernet)
- Time synchronous, steady output (real-time) with up to 16,384 parameters (64 DMX-Universes, all parameters in 16bit) in one network session
- Up to 32 multi-user sessions possible; 32 stations per session
- No compromise in performance through external channel processing – with up to 8 Network Signal Processors (NSPs) for Parameter Expansion and another 8 NSPs for more calculation power in the control system
- TCP Unicasting for grandMA remote control and FTP data transmission
- UDP for Multicasting
- Bidirectional data transmission for grandMA video and dimMA feedback
- Multiple User Protocols
- Support of MSC, MIDI and SMPTE Timecode
- Private IP-address range class C:  
IP192.168.0.0 -192.168.255.255, Sub-Net 255.255.255.0
- ACN and RDM ready

### The New Way of Counting: Channels or Parameters

The grandMA network calculates internally all functions (parameters) in 16bit resolution. One parameter inside the console will always stay the same (e.g. dimmer, pan, tilt, gobo, etc). Processing those parameters depends on the application – as a single DMX channel in 8bit resolution (e.g. brightness) or as two DMX channels per function in 16bit resolution (e.g. pan and tilt). This means that one parameter can be one 8bit or two 8bit DMX channel.

Here an example:

- Patching an 8bit Dimmer requires 1 parameter and 1 DMX-Channel.
- Patching a 16bit Dimmer requires 1 parameter and 2 DMX-Channel.

That's the reason why 4,096 parameters can require more than 8 DMX universes! A maximum of 16,384 parameters can be distributed in one multi-user-environment, while up to 32,768 DMX channels (all channels/fixtures are 16bit), with 16 NSPs as node and parameter expansion may be required for their processing.



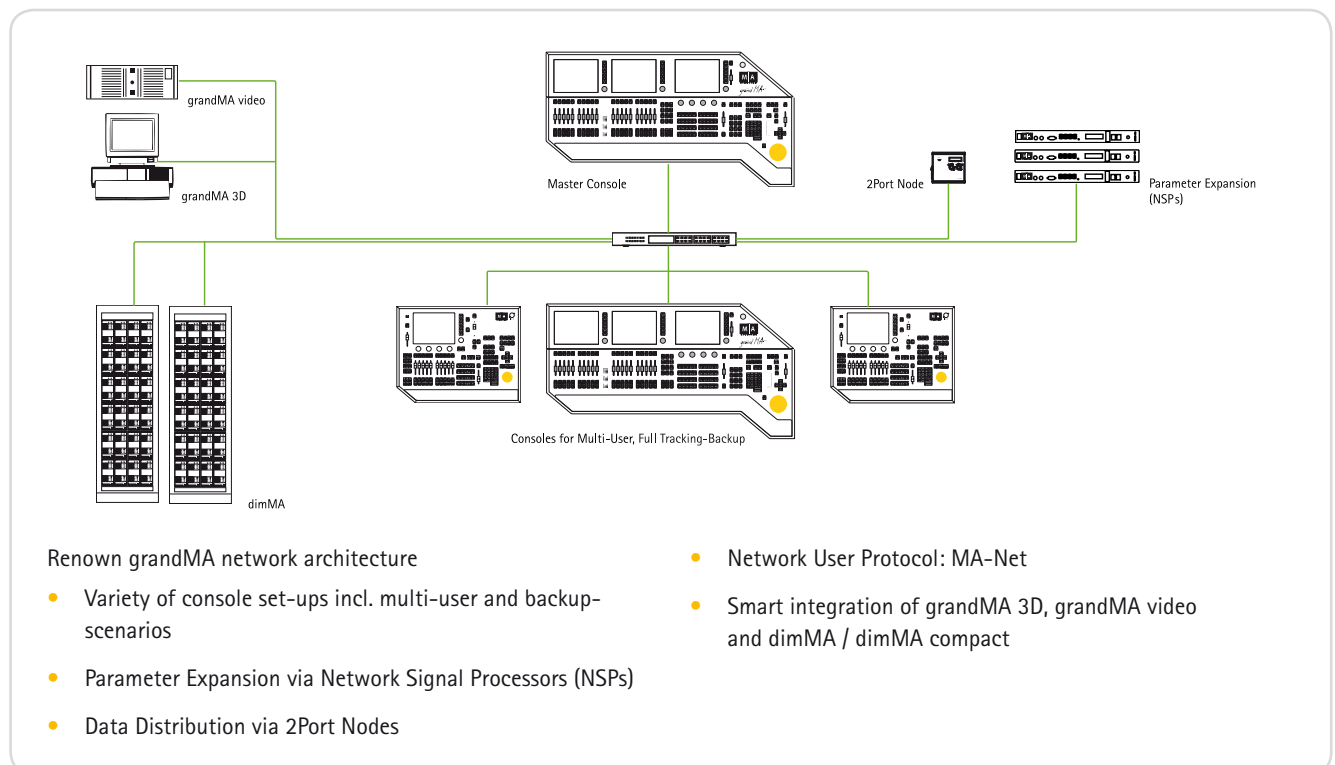
# grandMA multi-user sessions – Sophisticated control and backup solutions

With the unique multi-user functionality, up to 32 grandMA consoles\* or PCs with grandMA onPC, grandMA 3D and grandMA video can be linked together to program or control one single show. Each console operates with its own independent screens and command line, while sharing their combined processing power to create the show. Software updates are possible across the whole network via Ethernet. 32 of these sessions can be started in just one physical network.

This means that every single operator can control the complete show or just a sub-section from his console. Also each console can share six independent remote PDAs (grandMA micro / pico only one remote). This gives a totally new meaning to "multi-user" programming. For example in a TV show different operators work on the same show file. One operator may be controlling the camera lights (key lights), one controlling the moving-lights, one controlling some LEDs and another operator controlling the grandMA video. This gives a new meaning to the word cross-networking, especially to the world of media.

- Simultaneous programming and control of shows with up to 32 consoles\* or other components online offers sophisticated Backup and Control solutions
- Control of parameters, cues, etc. within virtual partitioned areas ("Worlds")
- Customized preferences for several operators incl. individual screen layouts ("User Profiles")
- Auto-save of show file in real-time within the whole network; parallel backup also at FTP-Server
- Hassle-free disconnection and reconnection of network sessions without requiring reset – but with show upload
- Master/Slave-assignment within the network via priorities

## System Overview grandMA 'series 1'

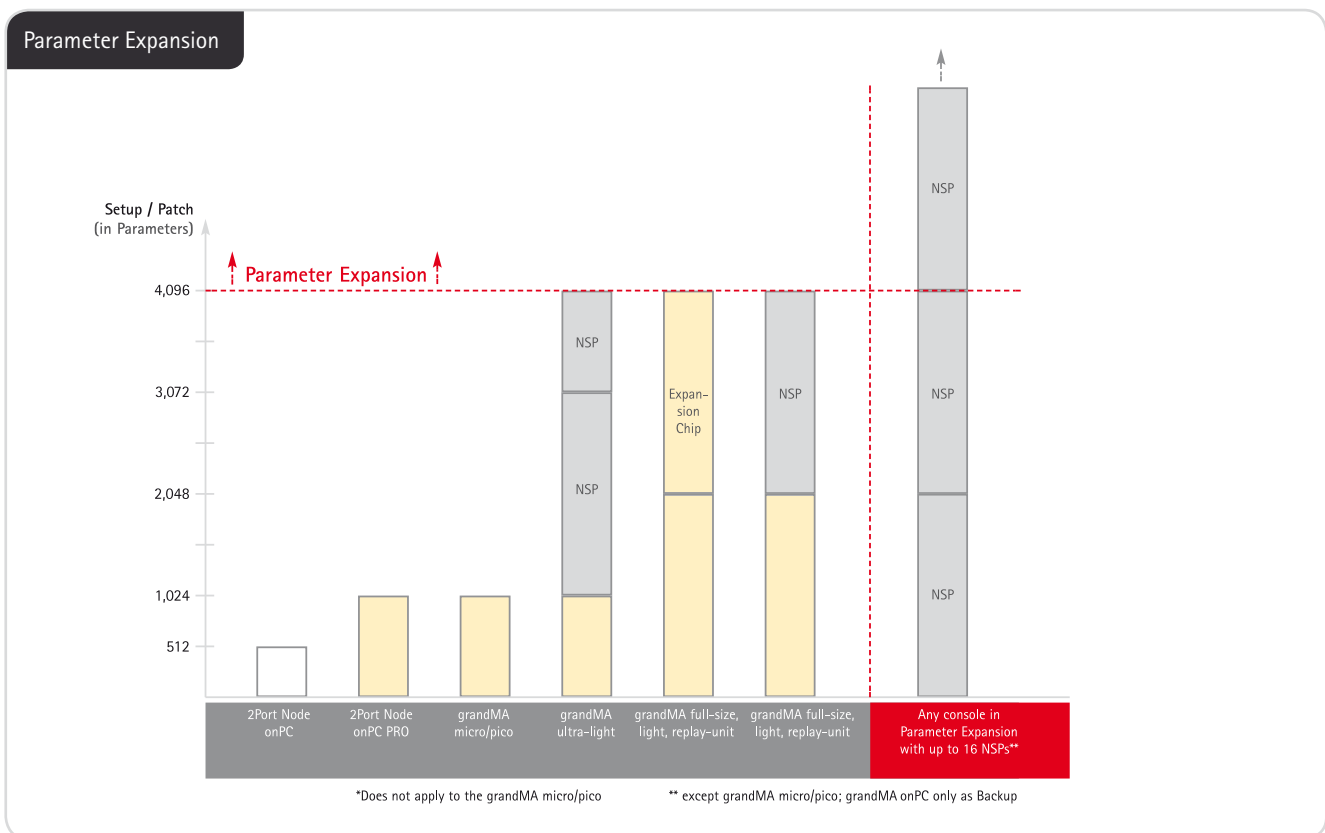


\* Does not apply for grandMA micro and pico

# Parameter Expansion

To control more than 4,096 parameters, NSPs must be used to calculate the additional DMX channel data. Using NSPs within a network means that data processing is now decentralized over Ethernet. The use of NSPs increases data processing speed and capacity for better performance over the whole system. Many combinations are possible. Maximum: 8 Network Signal Processors (NSPs) for 16,384 Parameter Expansion and another 8 NSPs for more calculation power in the control system.

If any help is needed to design a large networking system, please contact your local distributor or technical support.



## Multiple User Protocols

Multiple Ethernet-based protocols can be transported over the same network session:

- MA-Net and ETC-Net2 (free Dongle required) – up to 64 DMX Universes (depending on parameters)
- Strand Shownet – up to 36 DMX Universes (depending on parameters)
- Art-Net, Pathport and PortAll – up to 8 DMX Universes (depending on parameters)

# Enhanced networking with grandMA2

As described on previous pages, MA-Net is the powerful backbone of the MA system. As the internal system language it enables bidirectional communication with all hard- and software components of the MA-System. Just like the consoles of the grandMA series, this protocol is also expanded for future requirements. We call this MA-Net2. However, MA-Net2 includes first of all the same unique features as the MA-Net and there won't be any interference when running both on the same network (coexistence).

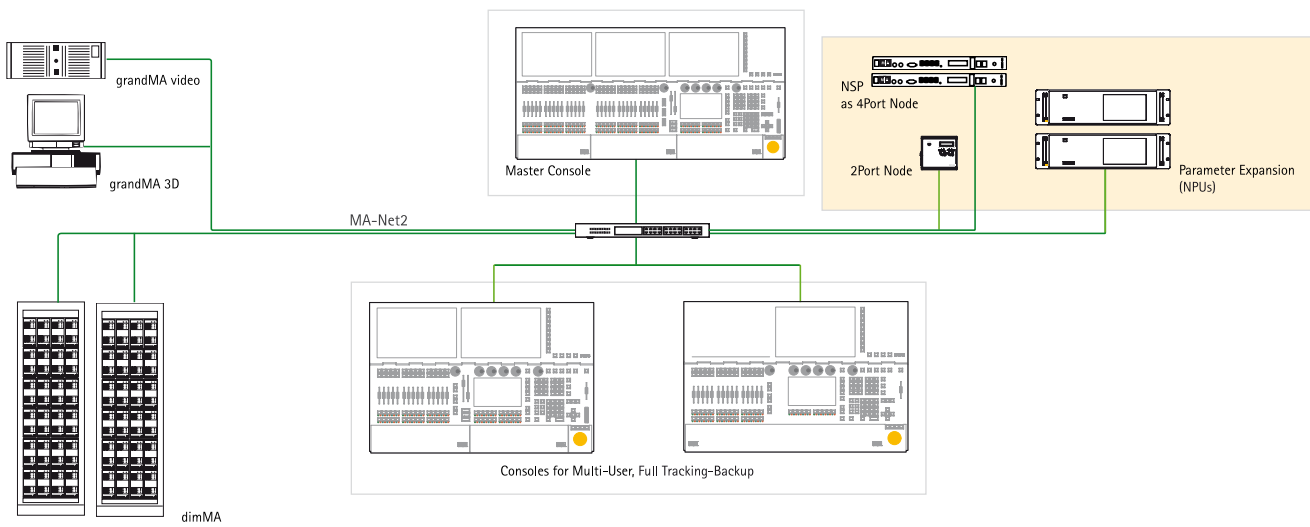
## Additional features of the MA-Net2

- 1,000 Base-T Ethernet (1 GBit/s – Gigabit Ethernet)
- Time synchronous, steady output (real-time) with up to 65,536 parameters (256 DMX universes, all parameters in 24bit each) in one network session
- Up to 32 multi-user sessions possible; 200 stations per session
- Expanded remote control functions
- Expanded feedback information for grandMA video and dimMA
- Automatically shared calculation power

## Enhanced Parameter Expansion

Another new feature of both the MA-Net2 and grandMA2 is the simplification of the Parameter Expansion. There won't be any separate Parameter Expansion mode any longer. Due to an enhanced networking architecture grandMA2 consoles automatically share calculation power within the network. Parameters only need to be expanded by adding one or multiple Networking Processor Units (NPU) to the system. The NPU adds 4,096 parameters to the session.

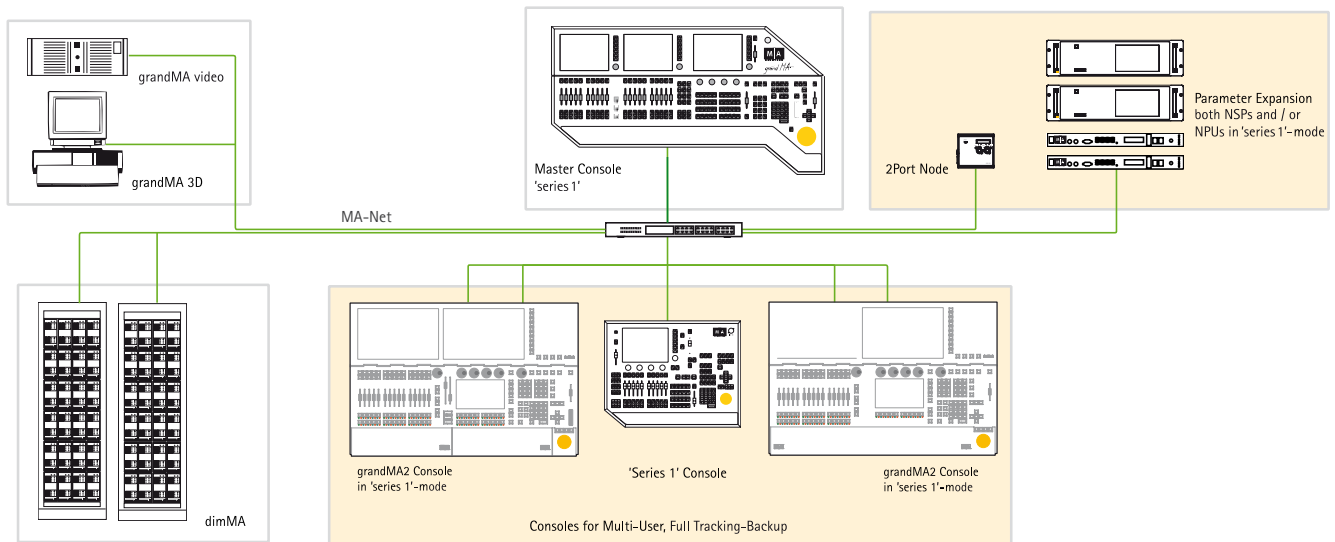
# System Overview – grandMA2



## New grandMA2 network architecture

- Variety of console set-ups incl. multi-user and backup-scenarios
- Parameter Expansion via Network Processing Units (NPUs)
- Data Distribution via 2Port Nodes and NSPs as 4Port Nodes in sniffer mode
- Network User Protocol: MA-Net2
- Smart and full compatibility of grandMA 3D, grandMA video and dimMA / dimMA compact

# System Overview – grandMA 'series 1' and grandMA2 in one system.



## Mixed grandMA and grandMA2 systems

- Variety of console set-ups incl. multi-user and backup-scenarios – grandMA2 consoles in 'series 1'-mode
- Parameter Expansion both via NSPs & NPUs in 'series 1'-mode
- Data Distribution via 2Port Nodes
- Network User Protocol: MA-Net
- Smart integration of grandMA 3D, grandMA video and dimMA / dimMA compact

# Mini Network Lexicon

## Network Overview

### OSI Model – Open System Interconnection

- A theoretical framework, which was published from the ISO in 1984, to simply demonstrate the data transport in a network
- The applications are divided in the following Layers:
  1. Physical Layer
  2. Data Link Layer
  3. Network Layer
  4. Transport Layer
  5. Session Layer
  6. Presentation Layer
  7. Application Layer

### LAN – Local Area Network

- A network that is restricted to a limited coverage, e.g. a building using short-range technologies such as Ethernet

### W-LAN – Wireless Local Area Network

- Wireless Ethernet standard (IEEE802.11)
- Most common is the 802.11g with 54 Mbit/s in the 2.4 GHz Band
- Segment length depends on several parameters like environment, antennas etc.

### VLAN – Virtual Local Area Network

- IEEE 802.1Q standard
- Enables one or more virtual local networks inside just one physical network to subdivide the network traffic

## Ethernet

### Ethernet

- A LAN technology which allows connected nodes to communicate with data-frames which carry the information
- Standardized transmission mediums, wire forms, bit encoding, data-frames and network-access rules (CSMA/CD)
- IEEE 802.3 defines different "Ethernet" Specifications (1-Persistent CSMA/CDs)

### CSMA/CD – Carrier Sense, Multiple Access/Collision Detection

- Network access rule, can be compared with a dinner party: Every participant listens a while before he speaks (CS) Once everything is quiet, everyone has the chance to talk (MA). If two or more people start talking at the same time, they detect that fact and are quiet and restart talking after a while (CD)

### 100Base-TX (copper)

- Predominant form of "Fast Ethernet" Standard (IEEE802 Clause 25)
- 100: 100Mbit/s Data transfer rate, Base: baseband mode, TX: 2 pairs of Cat5 twisted-pair cable
- 100 m (theoretically) max. segment length

### 1000Base-LX (fibre)

- Predominant form of fibre optic "Gigabit Ethernet" Standard (IEEE802.3 Clause 38)
- 1000: 1000Bit/s Data transfer rate, Base: baseband mode, L: long wavelength fibre optic, X: media segment is one of three based on the same block encoding scheme
- Segment length depends on the fibre optic material (single mode or multimode gradient)

# TCP/IP protocols and Routing Schemes

## Internet protocol suite

- TCP/IP protocol suite
- A set of communication protocols which let the Internet run, including TCP and IP

## IP – Internet Protocol

- The IP enables the data transfer in the network by giving every node an unique IP-address to identify the participant (RFC 791)
- The IP address consist of 4 bytes: w.x.y.z (e.g. 192.168.0.255)
- Analogy is a street address: town.street.building.apartment number

## Subnet mask

- Divides a continuous IP address range into several smaller ranges to design a more flexible network and reduce unnecessary data transfer
- The subnet mask consist of 4 bytes: w.x.y.z. (e.g. 255.255.255.0)
- In this case the first 3 bytes describe the Net-ID and the last byte defines the Host-ID (node)

## TCP – Transmission Control Protocol

- Can be compared with a certified letter (RFC 793)
- Build up a reliable virtual point-to-point connection of two nodes
- Always Unicast

## UDP – User Datagram Protocol

- Realizes fast and bandwidth-saving data transmission (RFC 768)
- Multicast / Broadcast possible

## Unicast

- The data will be transferred to only one node (point-to-point) in the network

## Broadcast

- The data will be transferred to all connected nodes in the network

## Multicast

- The data will be transferred to a user defined group in the network



# Entertainment Networks

## User Protocol

- A common term for Ethernet based protocols of different companies which take the entertainment data such as DMX over the network
- Analogy to the road traffic in different countries

## MA-Net

- 100 / 1000 Mbit/s Multicast User Protocol and internal language of the MA-Network

## MA-DMX Sniffing

- Special DMX encoding for secured data distribution

## Art-Net

- Most common 10 / 100 Mbit/s Broadcast User Protocol from Artistic Licence

## ACN – Architecture for Control Network – ANSI E1.17-2006

- ACN is an open modular standard of a software architecture, providing a basic structure and an accumulation of protocols, offering a new way to describe device functions and to access them via newly defined messages in a reliable way.
- ACN can also be combined with existing technologies and protocols to create a flexible network with interoperability.

# More protocols...

## DMX512 – Digital Multiplex

- Serial asynchronous 8bit standard protocol for controlling lighting equipment (USITT Standard)
- 512 channels per one physical line (universe)

## RDM – Remote Device Management – ANSI E1.20

- RDM allows bi-directional communication between e.g. a console and a dimmer.
- Pin 2 and 3 of the DMX512 cable is used to send and receive RDM data over one cable.

## MIDI – Music Instrument Digital Interface

- International standard of the Audio Engineering Society (AES) which allows the communication of electronic music instruments
- In entertainment used for remote control (e.g. via a fader board) and synchronisation

## MSC – MIDI Show Control

- Expansion of MIDI which supports the control of light, video and stage equipment additionally

## SMPTE Timecode

- Standard (SMPTE 0012M-1999) published by the society of Motion Picture and Television Engineers (SMPTE) for synchronisation of generally Video and Audio but also light equipment

## CAN – Controlled Area Network

- ISO 118981 standard which is a reliable serial data bus, with distance and nodes limitations
- Data rate depends on the distance (up to 1 Mbit/s)
- MA uses the CAN bus for dimmer communication

# Hardware, cables and connectors

## Node

- A device in a network, having e.g. an Ethernet interface

## Hub

- A distribution device which broadcasts all received data to all the connected receivers

## Switch

- A sophisticated distribution device which sends the data only to the required receivers

## CAT 1...7

- TIA/EIA 568 standard for categories of twisted-pair (TP) cable which define cable specifications (e.g. pin out, order for wire connection)
- The higher the category, the higher the twisting, the higher the quality, the higher the data transfer rate – Cat5 is used for 100Mbit networks

## RJ 45 – Registered Jack

- Standardized plugs and jacks of the Federal Communications Commission (FCC) for Telephone wiring with 8 pins – used in combination with TP-cable for Ethernet networks

## Ethercon®

- Rugged RJ45 connectors for harsh and demanding environment

## LC, ST, SC, E2000, FC, FSMA, MIC, MTRJ

- Diverse connectors for fibre optic

## OpticalCon®

- Rugged LC connector for harsh and demanding environments

## Crosslink cable

- TP cable with interchanged pin out to directly connect two nodes

## Shielding for TP – ISO/IEC-11801 (2002)E

- UTP                      unshielded twisted pair
- STP, FTP                shielding over every pair of copper wires
- S/UTP, F/UTP        only outer over-all shielding
- S/STP, S/FTP        individual and outer over-all shielding

# Network Rules

MA Lighting highly recommends to only use high quality sophisticated networking industrial equipment. The main idea is to implement a reliable network structure as well as a secured data distribution over a wide range of equipment and protocols by using the field tested reliability of common network products. Higher speed, more bandwidth, well equipped hardware is necessary to fulfill all modern needs of the lighting industry.

There is no "master" solution but some basic suggestions on how to design a network for the lighting industry.

## Hardware

- HP Procurve® or Cisco® switches and Routers etc. which have been field-tested on many large shows and network environments during the years. Do not use hubs, but use switches for an efficient network
- Use Ethercon® to RJ45 adapters to connect to a switch, use OpticalCon® to LC adapters to connect to a switch
- Wireless Remotes (PDA) or iPhone / iPod touch for a reliable TCP/IP connection to our consoles - do not use the remote for triggering shows, just for the ease of programming, configuration and focussing
- Uninterruptible Power Supply (UPS) which are already built in our consoles\* for guaranteeing no show interruption and show upload during the show in case of current interruption. The 2Port Nodes for example do not have a UPS as they are working only in "Sniffer" mode. There won't be any show upload in case of failure. Always put the critical devices of the network on UPS, e.g. Switch / NSP / etc.
- Power over Ethernet (PoE) Injector help out where only one or two PoE Ports are needed, while a switch with power over Ethernet is the better choice for multiple feeds of PoE. PoE can be used for 2Port Nodes and LAN access points

## Cables & Connectors

### Copper

Different cable types for different applications:

- For fixed installations use cable with solid core where the cable can remain rigid. For patching and environments where the cable must be flexible use stranded core cable
- Shielding depends on the environment, with S/FTP you have no borders
- Twisted Pair (TP) – CAT.5e (useable for Gigabit-Ethernet) cable which has a better signal to noise ratio than CAT.5
- For System-Installations of Light, Video, Sound, etc. use CAT.7 (e.g. Helukat®) or CAT.6a to be prepared for further applications with 10 Gigabit
- Neutrik Ethercon – rugged metal housing for RJ45 – cable connectors for mobile productions in rough environments particularly in the touring sector
- Standard RJ45 connectors for patching

### Fibre

- We use 50/125 µm Multimode (850nm) fibre cables
- LC Connectors are suitable to convert via an Gigabit-LX LC Mini-GBIC (electrical/optical interface) to the electrical world. There are different media converters available on the market which transform data to Cat.x and backwards. That is an easy solution for expanding the segment length.
- Neutrik OpticalCon® – rugged metal housing for LC-cable connectors for mobile productions in rough environments particularly in the touring sector
- Cable reel with OpticalCon® for mobile production e.g. from Sommer Cable® with SC-OCTOPUS® fibre cable

\*Does not apply for grandMA ultra-light, micro and pico

## Tips & Tricks

- Not every Ethernet-based User Protocol can speak to another - it depends on the implementation of the equipment
- "Fast Ethernet" and "Gigabit Ethernet" networks must be wired starlike - daisy chain is not allowed
- For "Fast Ethernet" and "Gigabit Ethernet" a network segment (distance between a switch and a node) with flexible copper cables shall be maximum 70m long (theoretically 100m is possible)
- A network segment (distance between a switch and a node) with 1000 Base LX and Multimode fibre cables (50/125µm) shall be maximum 550 m long
- Use Crosslink cable for a straight connection between two nodes/devices - only for tests
- Consider the different minimum bend radius of the cables
- Avoid crossing mains cable - if unavoidable install only at 90° to reduce induction
- Use cables to set up your lighting system - use wireless technologies just for special applications
- If cables run through conduit use separate conduits from main power cables

## MA specific rules

- Watch out that the streaming version of all MA components is always the same to assure full functionality. On our webpage you will find the software with the following conventions:

Productname\_[Streaming gMA2][Streaming gMA1]\_vVersion

The important information will be the numbering in the brackets. This numbers must fit together to get the software connecting to each other on the network as well as to be able to interchange showfiles.

- grandMA video, grandMA video admin and grandMA 3D cannot update another control station
- For MA-Net use IP Address Range: IP 192.168.0.1...254, Subnet 255.255.255.0 for all components
- Every device in a network needs a unique IP address - do not duplicate IP addresses as this would cause data collision
- Use MA-Net for the backbone of an MA lighting system - use the other user protocols to control lighting devices or for special network expansions
- There is always just one session master and one or more slave components in a network
- For every MA network you need at least one piece of MA hardware
- MA uses only 2.x.x.x addresses for Art-Net (automatic configuration)
- grandMA onPC is limited to two NSPs (4,096 parameter)

Please contact us for further information and specifications.

## Network Protocols and Standards

Taking the fast development of our industry and constantly increasing requirements in terms of control performance and network design into consideration, new forms of technical communications are needed. The 'Architecture for Control Networks' (ACN) shall offer a structure to create network protocols for specific use in the lighting entertainment industry. Since an open standard like ACN takes a while to be developed and agreed on – most of the leading manufacturers in lighting control have already created their own network protocols.

Nowadays, there are two main different protocols on the market. We distinguish between "Transport Protocols" (e.g. Art-Net) and "Real-time Protocols" (e.g. MA-Net). ACN shall cover both ideas, but due to too many different philosophies of the manufacturers, we believe it will take a while to work in the ideal way. However the first part of these protocol suites will be the DMX Streaming Protocol (DSP). Practically it works like the Art-Net protocol which just transports DMX data over Ethernet. Therefore and as long as ACN does not provide further performances the MA-Net protocol is more sophisticated. It combines real-time and frame synchronous control of up to 256 DMX universes (MA-Net2), dimMA feedback, video control and feedback integration as well as any in- and output via Ethernet.

MA-Net/MA-Net2 will stay the reliable backbone of the grandMA system including all integrated MA Lighting products! Anyway we will support ACN on its way into our lighting entertainment industry to develop it to a full frame of protocols that will help all of us to interconnect in a better way.

The Remote Device Management (RDM) is also future orientated. It is an advanced protocol that offers feedback via standard DMX cabling. In smaller systems, or already existing systems that do not provide any Ethernet cabling, this protocol will be the ideal way to have feedback to the control system. In new environments we already see a step into Ethernet technology that enables the control systems to get hold of much more information in a faster and easier way. Therefore RDM will be a part of the overall puzzle and we value and support this as an additional tool to provide existing installations or smaller systems with feedback information.

# MA-Net – Practice proved technology

Please find herewith an excerpt of installations and projects with MA Lighting products, we did in co-operation with our international MA distributors, renowned designers and/or installation companies. For further projects, please have a look at our website [www.malighting.com](http://www.malighting.com).

## Concert Touring / Live Events: The Police World Tour 2007

"The Police" started its international reunion tour 2007 - Sting, Andy Summers and Stewart Copeland went out on the road again after 24 years.

The show is controlled by a full-size console combined with another full-size as backup solution.

A fibre optic backbone connects the three switches which bring the grandMA consoles, NSPs and MA mediaPCs with the fixtures into the network. Fibre optic was chosen because of the long distances that needed to be covered and to get a reliable high speed network because of the 100 Mbit/s working speed of the MA-Net.

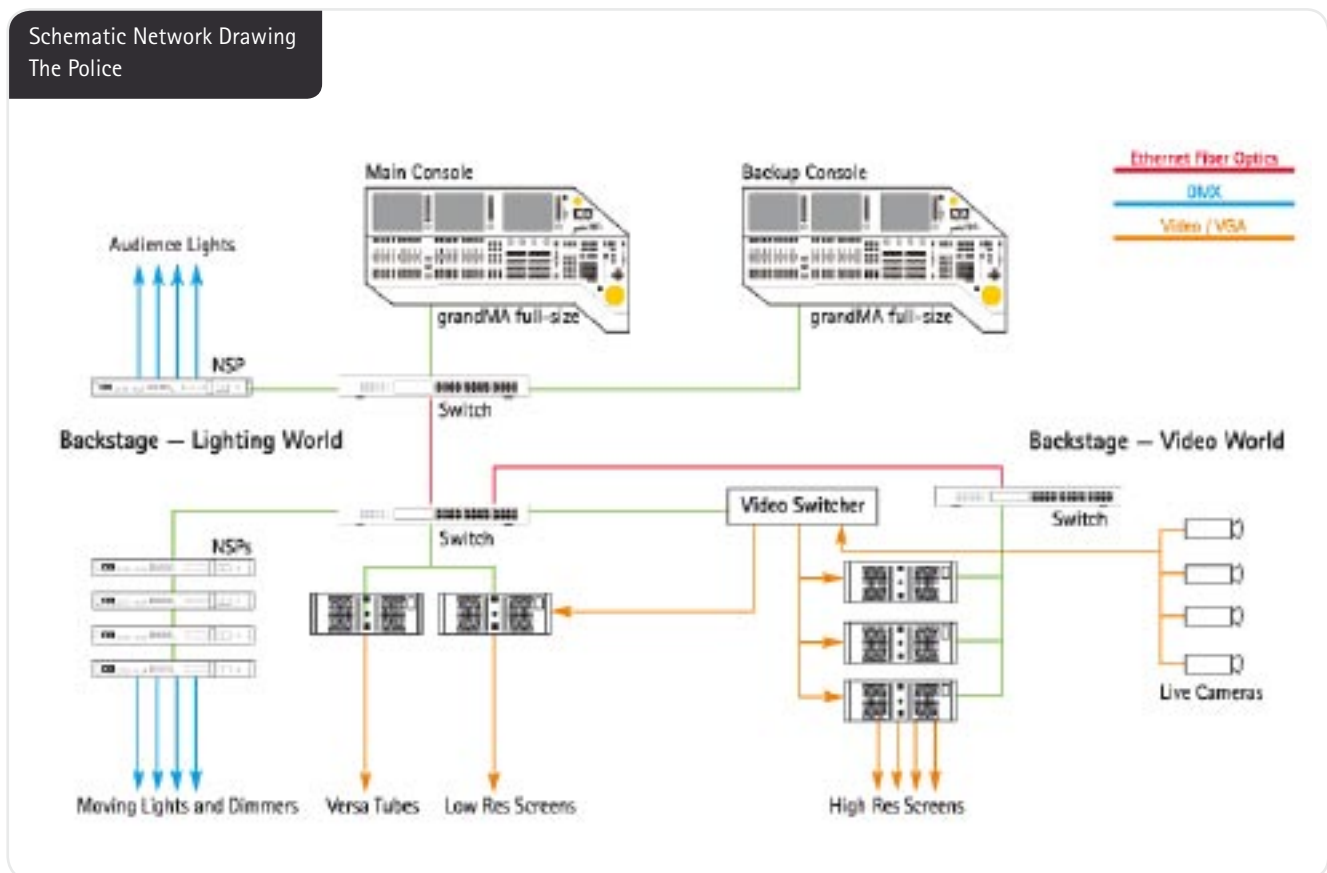
The three switches connect the different network areas: FOH, Lighting World and Video World. The MA NSPs are installed locally, used for external calculation and Parameter Expansion.

They make the desk to a server system scaleable with no extra processing drag on the desk. They are also the interface between the MA-Net and the DMX-World. One is placed at the FOH for audience lighting while the remaining four are positioned backstage to control the Moving Lights and the Dimmers.

In the Lighting World one grandMA grandMA video supplies a 15 x 12m low-res LED screen and another one the 215 x 2m LED VersaTubes with Video data. In the Video World the other 3 grandMA video systems feed the high-res screens.

High-res video first passes through a video switcher which also sends live feeds and imagery from a Doremi server to the high-res screens. grandMA video offered the possibility to format the Versa Tubes and the two side screens as a complete map with images expanding from the middle.

Schematic Network Drawing  
The Police





## Theatre / Musicals: Operaen Copenhagen

The Operaen's main stage installation needed more than 1,200 conventional dimmer channels of 5kVA, followed by 636 "non-dim" channels and approximately 200 moving lights remotely controlled luminaries, colour changers and other non "conventional" fixtures. Additionally the audience room was illuminated by 1,100 LED fixtures including the possibility to control them via the stage lighting network directly.

The main stage of the Operaen is controlled by a single grandMA full-size, supported by three MA NSPs (Network Signal Processors) that are just providing the necessary processing power for more than 4,000 control channels, with some spare capacity to act as backup. The grandMA replay unit runs in parallel to the main console and stays live and "on-line" even when the main system is powered down.

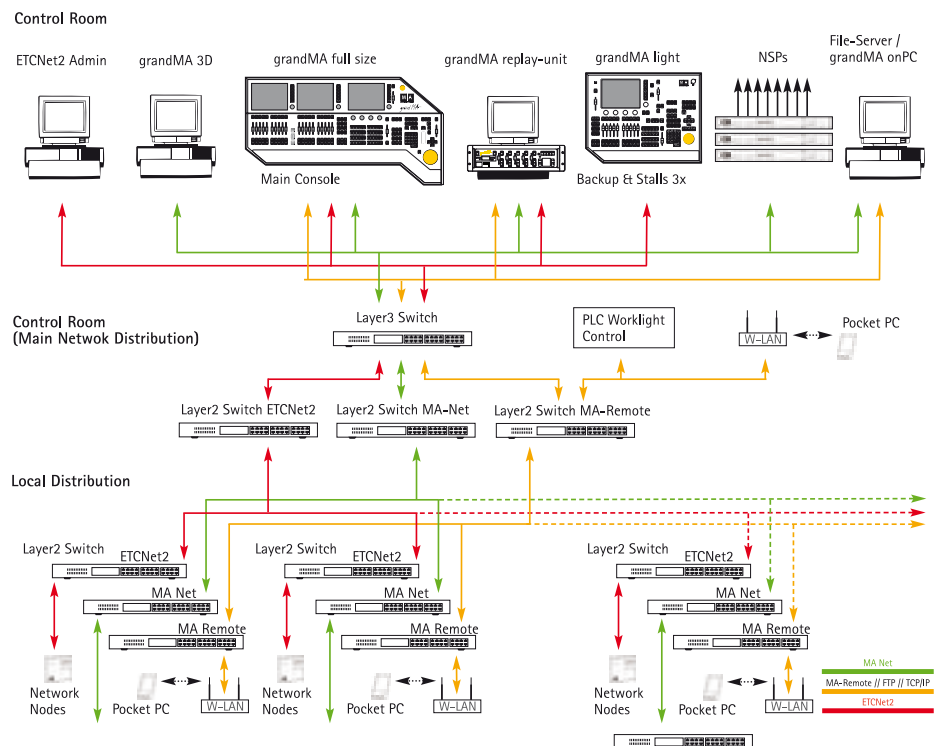
Four handheld Pocket PCs featuring grandMA remote software, enable the lighting technicians on stage to call and focus fixtures without using the main console even if the consoles are turned off. The Pocket PCs are linked to the main network via a large WLAN comprising eight access points, distributed throughout the building and performing a "roaming" facility to each remote control similar to cellular mobile phone networks.

For more sophisticated control two additional touch panel PCs with grandMA onPC software are used on stage. Another console, a grandMA light, is used as a portable rehearsal desk and resides on an additional backup in the control room during performances.

But that's still not all for backup: an additional server PC located in the control rack runs grandMA onPC software and features a FTP server in parallel as global secure data storage for all consoles' show data. A grandMA 3D is running in the system to visualise the programmed show.

The challenge for MA Lighting was to adopt the ETCNet2 protocol which had already been put in place to avoid the use of a DMX bottleneck solution. As all the dimmers and 120 network nodes were already listening to ETCNet2 via Ethernet it was the most reliable solution to add this protocol to the grandMA software's multi-protocol stack. The console is able to speak both protocols at the same time.

### Schematic Network Drawing Copenhagen Opera House



TV / Studios: German Pop Idol  
(Deutschland sucht den Superstar)

22 MA mediaPCs running grandMA video software together with a sophisticated MA Lighting network were the backbone for the fourth season of "Deutschland sucht den Superstar" (German Pop Idol). The MMC studios in Cologne furnished the studio with 150 moving lights and conventionals, Barco O-Lite and I-Lite LEDs and scores of plasma screens.

The control of grandMA video, Moving Lights and Conventionals was divided in different sessions for video and lighting. Furthermore 2 switches separated the lighting and the video world. The first switch connected 2 NSPs which took over power calculation and outputs the DMX signal. The second switch fed the MA mediaPCs with MA-Net to distribute the data and enables bidirectional data communication. This offered Thumbnail Preview in the console, remote shutdowns or reboots of MA media PC from the console and many more features.

The Barco I-Lite wall in the centre of the stage was driven by one MA mediaPC. To ensure highest system stability, another one was used as backup.

The 40 plasma screens on stage were controlled in groups. The output signal of the eight MA mediaPCs, which were controlling the plasma

screens, were first going through a scan converter to adapt the signals to the conditions of a TV show. Furthermore the second Input of the scan converters enable the use of the signal from the stage direction for the output equipment.

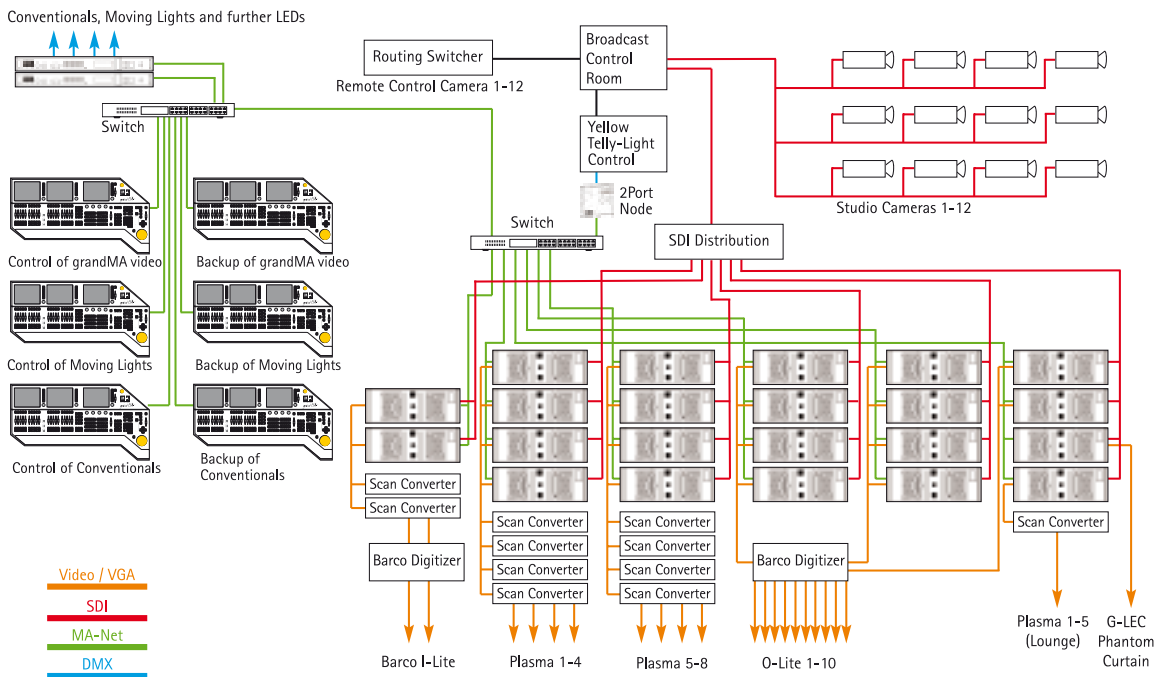
Another MA mediaPC was responsible for all five plasma screens in the lounge area.

The Barco O-Lite needed 9 further MA mediaPC and the G-LEC Phantom Curtain another one. Just one MA mediaPC was required to backup 19 MA media PCs. The backup server could take over the job of all other medias by one click and one switch on the output.

The signal of 12 studio cameras was used for Input data to the MA mediaPC's.

The production of the German Pop Idol led to the development of a special feature for the show. The control of the yellow tally-lights on the cameras was directly implemented into the grandMA. This was a huge advantage regarding the use of live pictures on stage indicating to the director of photography and the side crew always which camera was "on air".

Schematic Network Drawing  
German Pop Idol



## Architainment: Stadion Center Vienna (SCV)

The SCV is a state-of-the-art shopping mall where an ambient lighting design and a mood management from a mixture of different LED fixtures matching the architectural characteristics.

The main console is represented by a replay unit which offers all the possibilities of the MA system. The replay unit can be remote controlled via a Touch Board for easier user control. The DMX Feed-back through the touch board indicates the user which buttons were pushed.

The Backup of the replay unit is realised with a grandMA onPC.

8 NSP are installed to add enough processing power to the system and to expand the full 16,384 parameters to the system. This is necessary to calculate and output the more than 14,200 DMX parameters synchronously.

To control the house lighting an interface between DMX and the European Installation Bus (EIB) is integrated. It is also possible to trigger sequences from an Info Counter in the SCV which is sent over EIB to DMX to the replay unit.

The long distance LAN is bridged by fibre optic cabling with Media converters, LevelOne 100BaseTX to 100BaseFX. After Re-Converting to copper 21 MA 2Port Nodes were installed to output the DMX

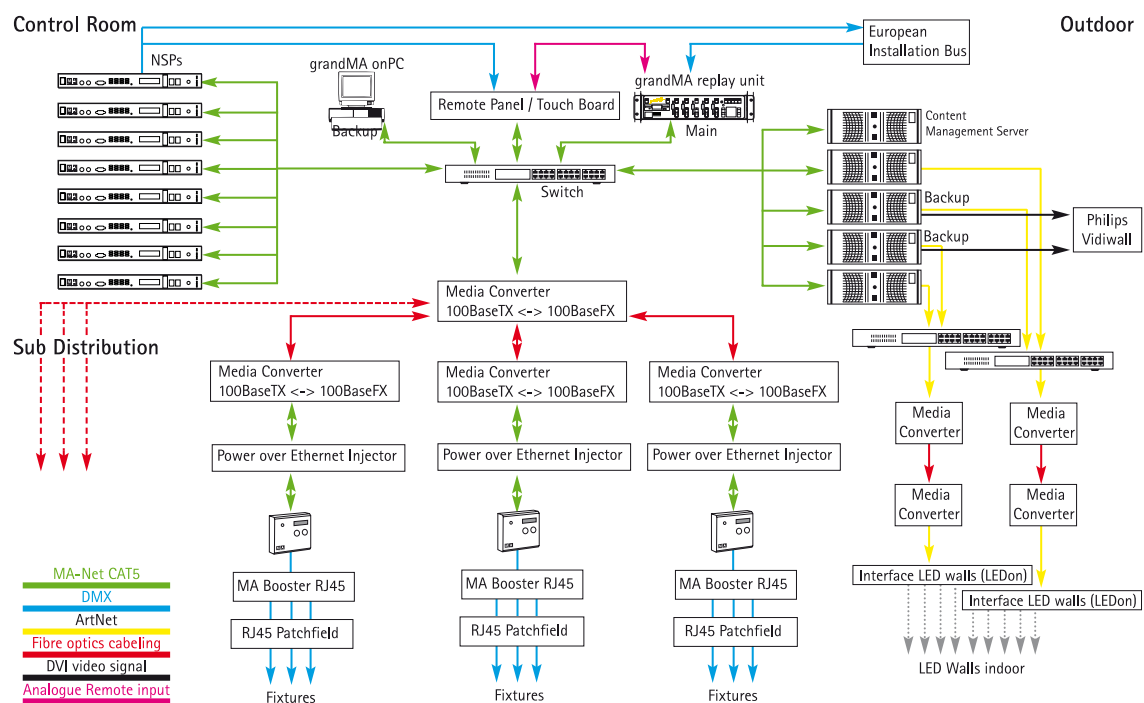
signals wherever they were required. The Power supply for the 2Port Nodes is provided by a Power over Ethernet Injector. The Booster splits the DMX signal to 8 outputs and is then distributed over a patch field to the different LED fixtures.

Two MA media PCs are running in 'Pixel Mapper' mode to control the nine ceiling mounted interior LED video walls. The outside installed LED video grid is fed by another one which is outputting DVI signals. The Indoor and Outdoor Backup are realized by another MA media PC. The fifth is used as additional storage and platform for third party content management.

A secured virtual private network connection (VPN) enables the system for remote maintenance purposes via the World Wide Web.

MA-Net is used for the inner system to build up a fast, reliable and efficient network. It also transports DMX and grandMA video Feedback data. Art-Net is used to transport the DMX over Ethernet after the MA media PC. DMX and DVI Video are the data signals which can be understood by the fixtures.

Schematic Network Drawing  
Stadion Center Vienna



## Company Profile

MA Lighting International, based in Paderborn, Germany, is the dedicated sales, support and service entity for the renowned grandMA control systems, digital dimming systems, networking tools and media solutions of MA Lighting Technology, based near Wuerzburg (GER). The product range offers cutting-edge solutions for control and dimming, including the award-winning grandMA consoles, the popular Light- & Scancommander and reliable digital dimmer racks and packs. With its MA mediaPC, grandMA video, MA bridges the lighting and video worlds.

Today, MA Lighting is respected for its technical knowledge and has achieved a unique international reputation for its operational philosophy. The company offers 25 years experience and strictly follows a professional user-centric approach, getting as close as possible to the market via its own international offices and support centres in the UK, North America, Latin America, the Middle East/India and Asia Pacific – supported by a world-wide distribution and service network.

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MA Lighting International GmbH  
An der Talle 24 - 28  
33102 Paderborn / Germany  
Phone: +49 5251 688865 -10  
Fax: +49 5251 688865 -88  
info@malighting.com  
www.malighting.com

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MA Lighting UK Ltd. · 55 Lonsdale Road · London NW6 6RA · United Kingdom · Phone: +44-20-7625-4371 · infoUK@malighting.com

MA Lighting North America · managed by A.C.T Lighting, Inc. · 5308 Derry Ave. Unit R · Agoura Hills CA 91301 · USA · Phone: +1-818-707-0884 · sales@actlighting.com

MA Lighting Latin America · Phone +55-9465-2604 · Nextel + 55\*30\*73441 · infoLATINOAMERICA@malighting.com

MA Lighting Middle East / India · P.O. Box 6491 · Dubai · Phone: +971-4351-3207 · infoARABIA@malighting.com

MA Lighting Asia Pacific Pte Ltd. · Block 10 Ubi Crescent · #06-28 Ubi Techpark (Lobby B) · Singapore 408564 · Phone: +65-6513-1897 · infoASIA@malighting.com