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Introduction to DMX

BU Controls
2008

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Objective

- Explain simplified functioning of a DMX control system

- Provide basic technical clarification

What is DMX

The origin of the abbreviation of DMX is unknown.
However it is often explained as Digital Multiplexed signal

It is a protocol, in which a DMX controller communicates
  to DMX luminaires

          In other words

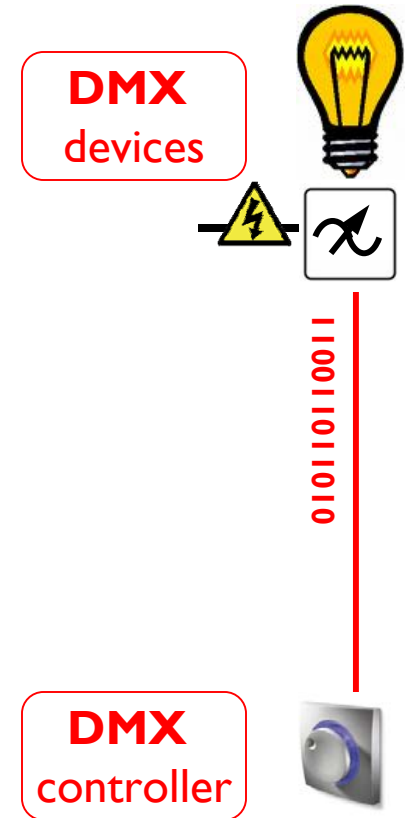DMX is the language in which DMX controller talks to
  DMX luminaires

DMX
devices

DMX
signal

DMX
cable

DMX
controller
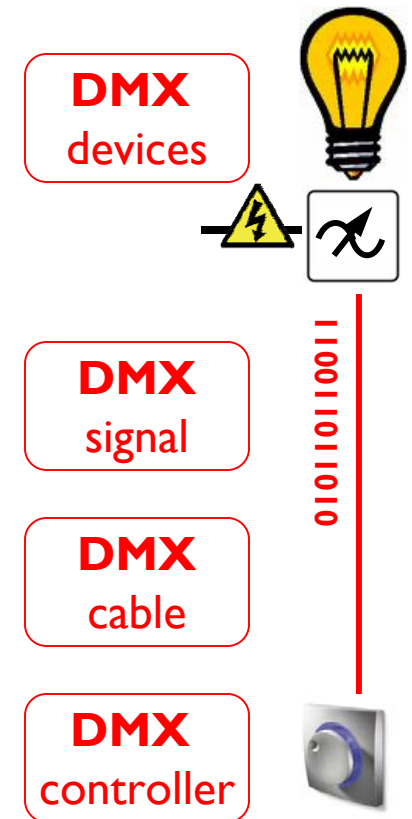
Examples of DMX products

Luminaires
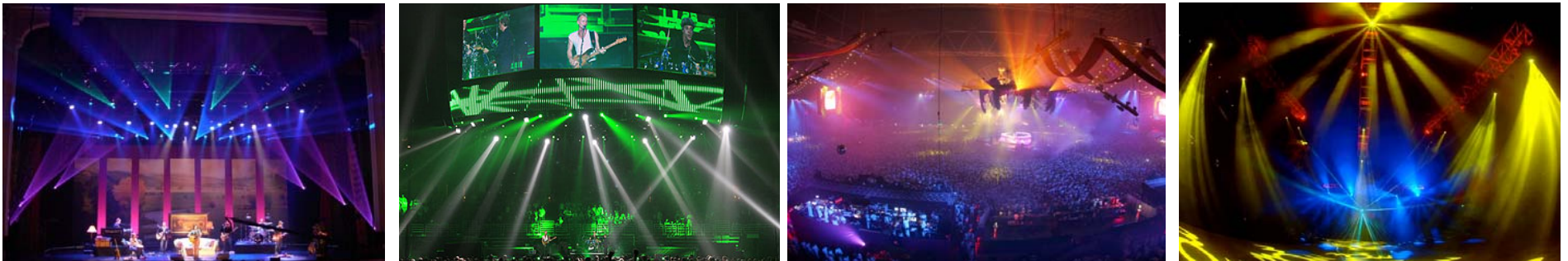
Switchpacks

DMX devices
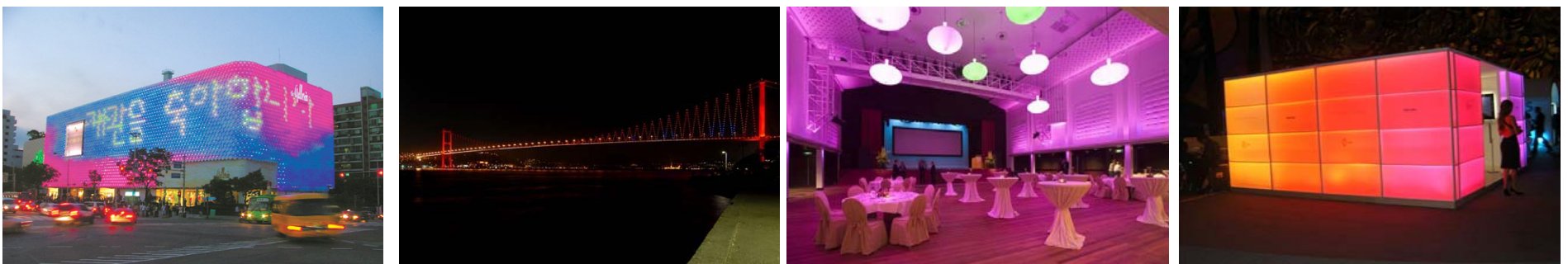
DMX controllers

DMX controller

History of DMX

DMX originated in the world of theatre was developed by USITT in 1986. DMX is used mainly for "controlling lighting equipment and accessories" in entertainment applications (theatre, staging, concerts etc)
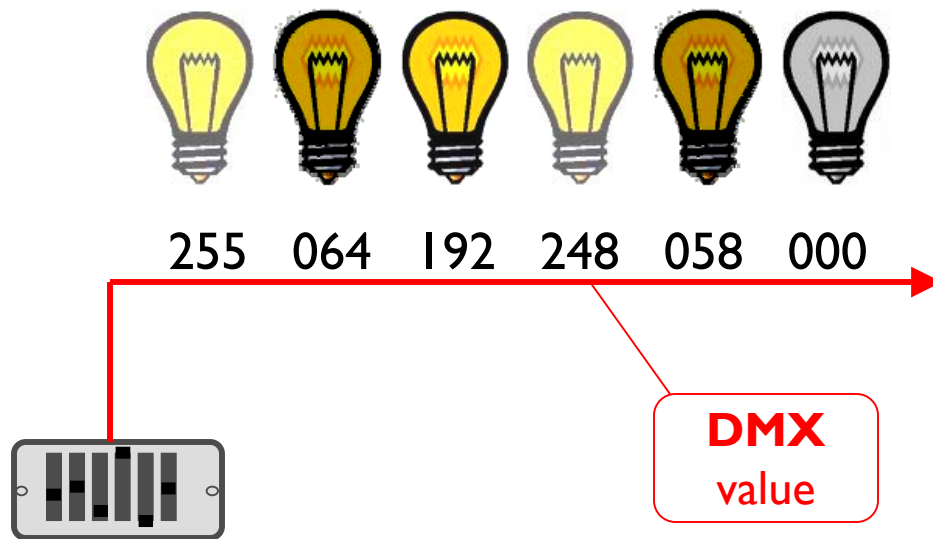

Nowadays DMX is used more and more in architectural scene setting applications as well.

The DMX signal explained

A DMX controller sends DMX values.

This is a 8-bit value (value between 0-255) corresponding to a 0-100% intensity

255   064   192   248   058   000

DMX
value

DMX Value	Intensity	
0	0%	
64	25%	
128	50%	
192	75%	
255	100%	

DMX
signal

01011011010

The DMX signal explained

Strings of 512 values are send 40 times per second.
The location of a DMX value is referred to as "address"
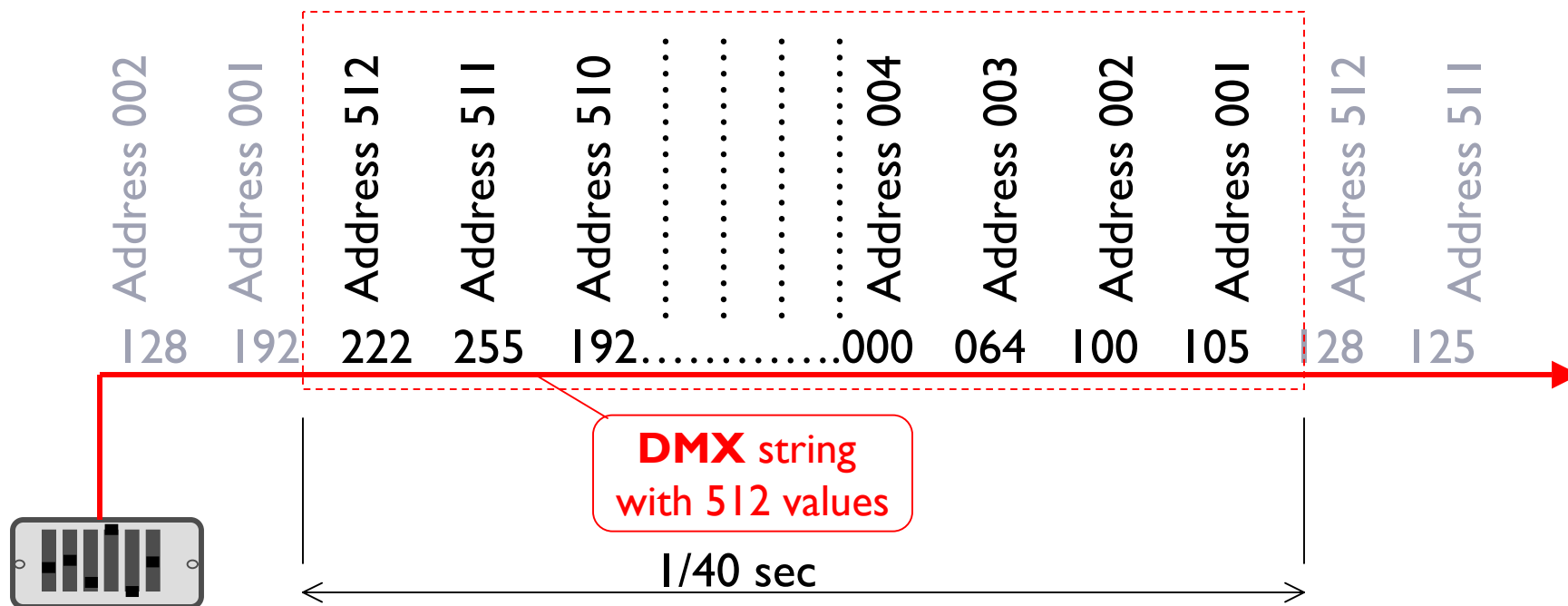
Address 002	Address 001	Address 512	Address 511	Address 510	⋮ ⋮ ⋮ ⋮	Address 004	Address 003	Address 002	Address 001	Address 512	Address 511
128	192	222	255	192............000		064	100	105		128	125

DMX string
with 512 values

1/40 sec

The DMX signal explained

By addressing the DMX device, it knows which DMX value to use

Address 006 Address 005 Address 004 Address 003 Address 002 Address 001

000 255 255 192 064 128

50% 25% 75% 75% 0% 100%

Address 001 Address 002 Address 003 Address 003 Address 006 Address 005

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The DMX signal explained

By addressing the DMX device, it knows which DMX value to use

Address 006 — Address 005 — Address 004 — Address 003 — Address 002 — Address 001

255 128 128 128 192 192

75% 75% 50% 50% 100% 50%

Address 001 | Address 002 | Address 003 | Address 003 | Address 006 | Address 005

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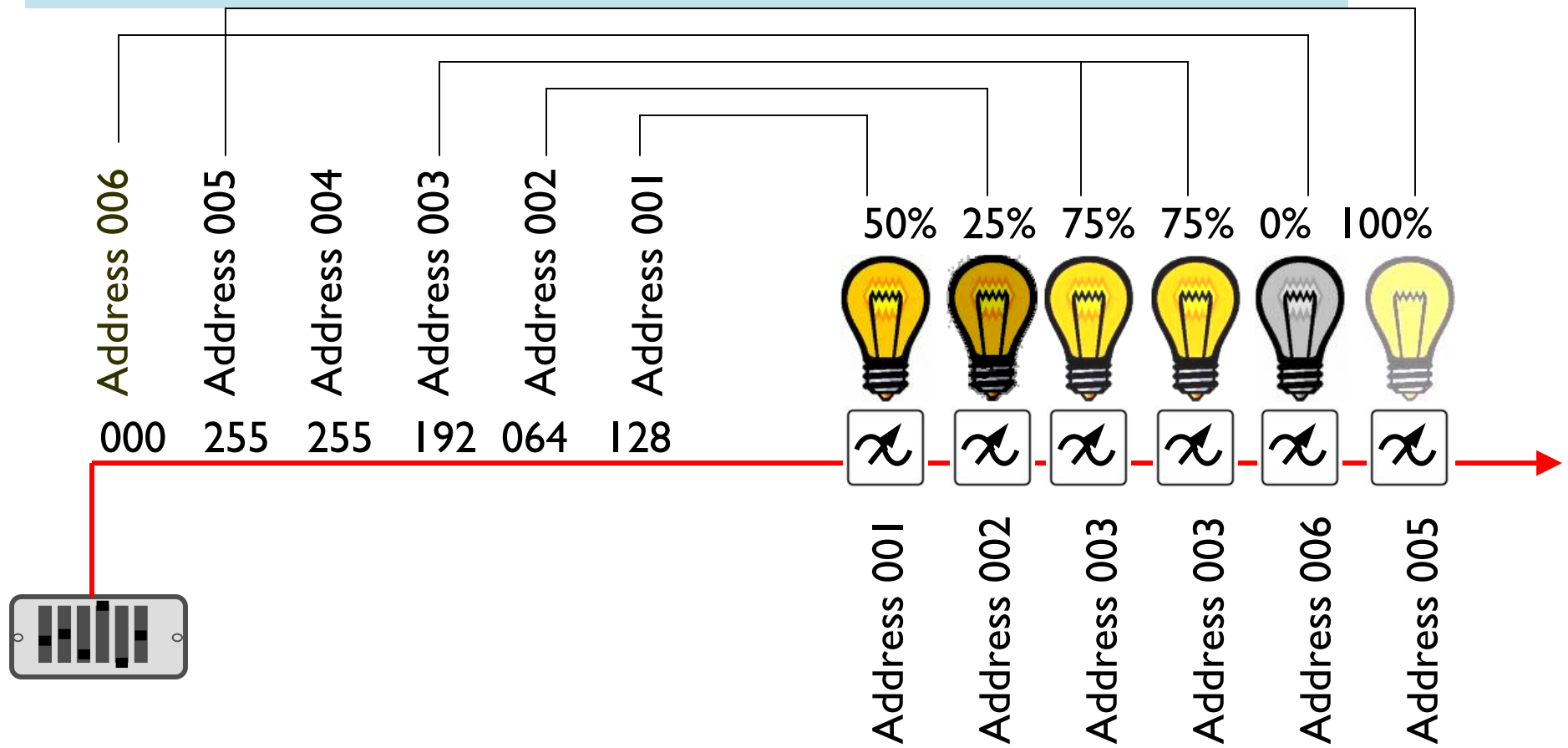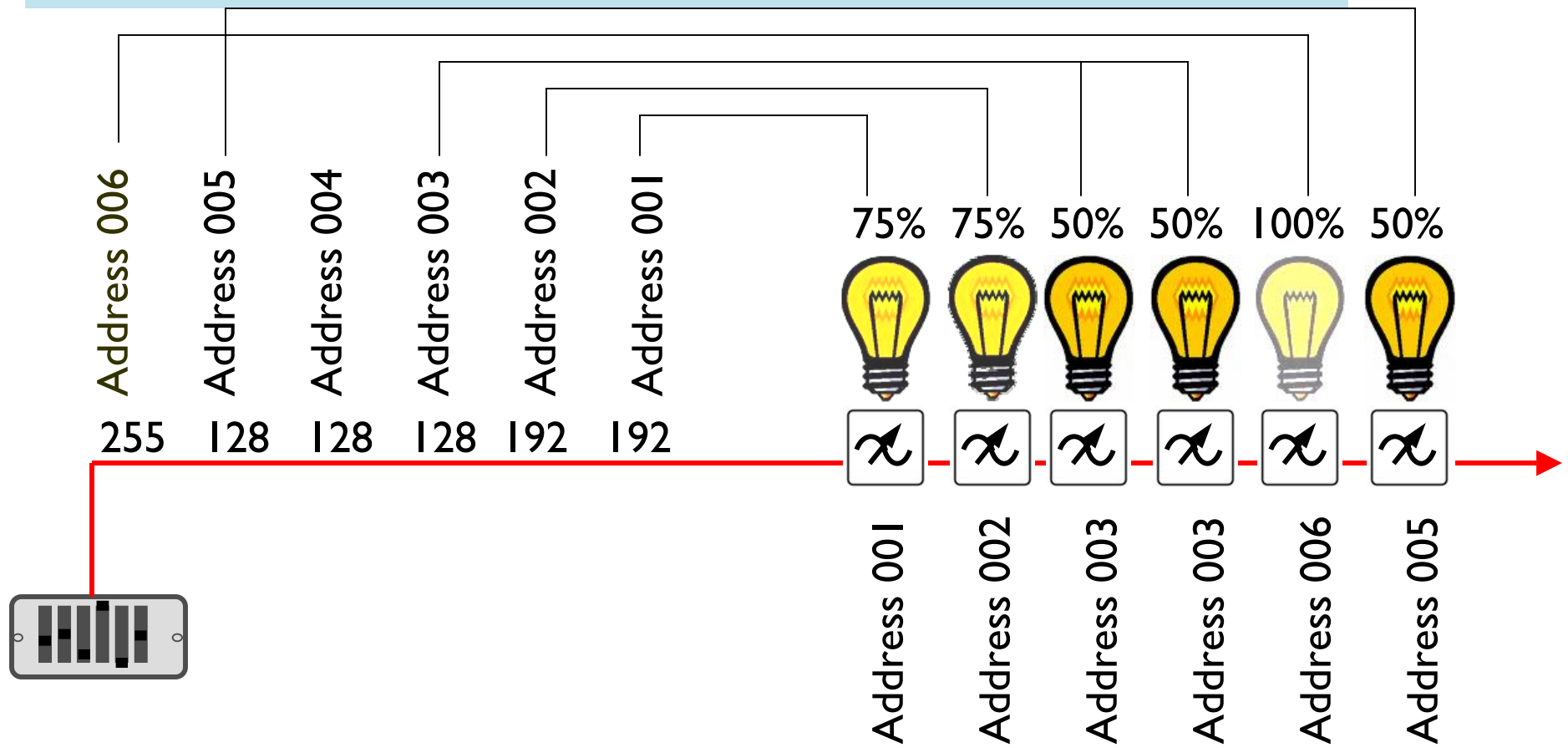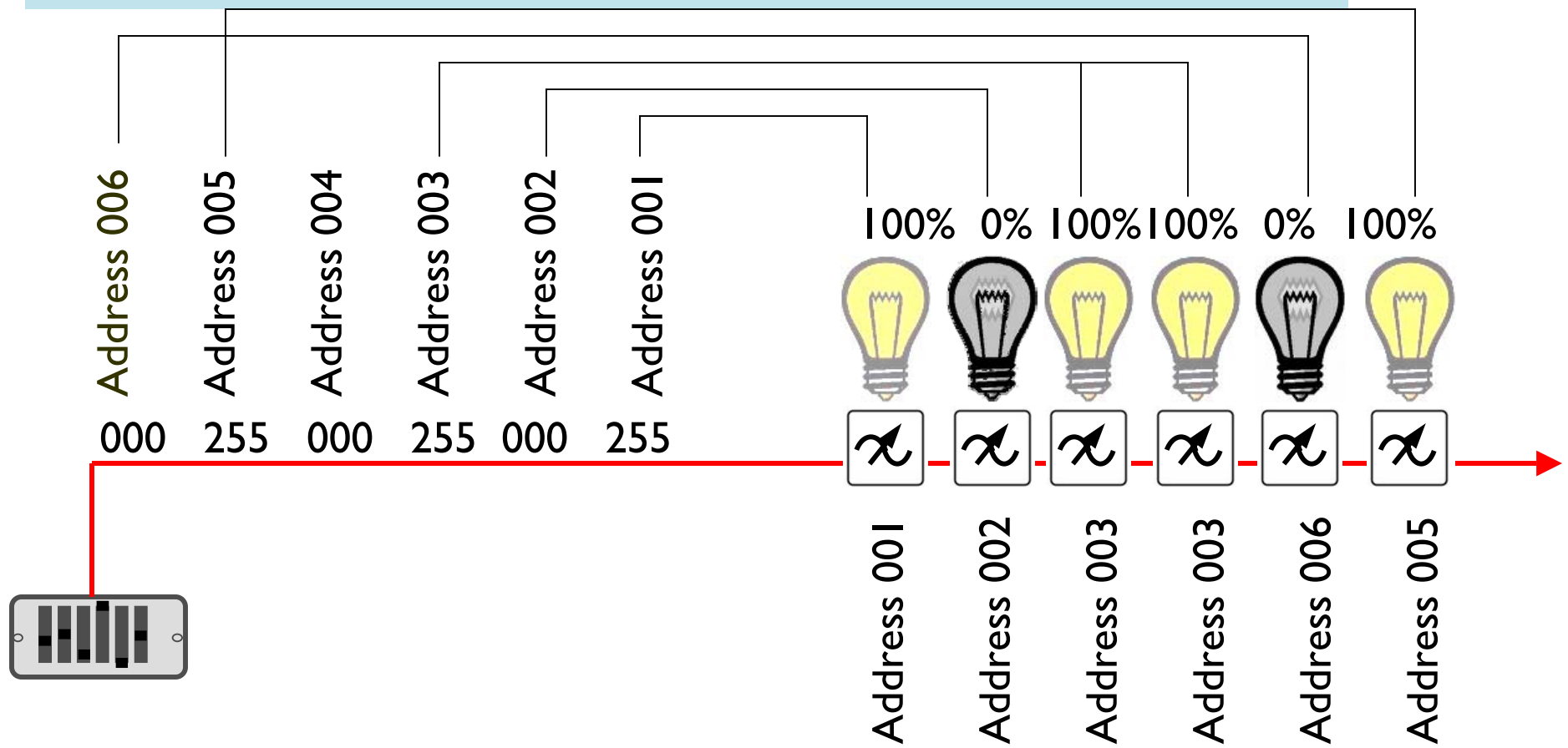
The DMX signal in scene setting

Most DMX devices use more then one DMX-address

In example, the LED LINE2 uses 3 DMX addresses.

1st   DMX value determines the intensity of RED,
2nd   DMX value determines the intensity of GREEN
3rd   DMX value determines the intensity of BLUE

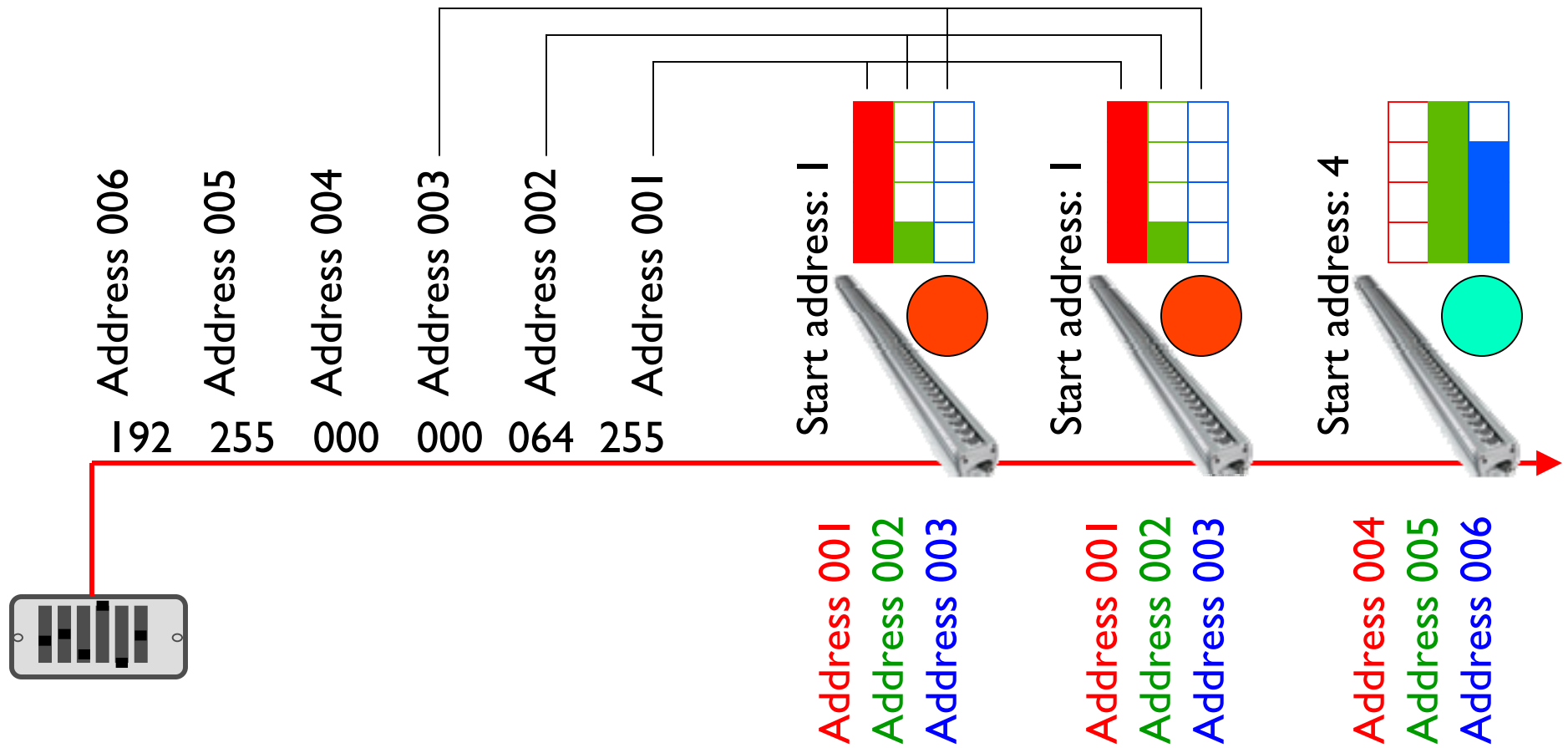The DMX-start address is the first DMX value used,
   (DMX-start address+1) the second value, etc.

Start address:	1	4	22	215
DMX addr. Red intensity:	1	4	22	215
DMX addr. Green intensity:	2	5	23	216
DMX addr. Blue intensity:	3	6	24	217

One DMX line can control 512/3=170 individual RGB units

The DMX signal in scene setting

The DMX signal in scene setting

With changing the DMX values, different colours are created

Address 006	Address 005	Address 004	Address 003	Address 002	Address 001
064	192	128	064	192	128

Start address: 1

Start address: 1

Start address: 4

Address 001 Address 002 Address 003

Address 001 Address 002 Address 003

Address 004 Address 005 Address 006

The DMX signal in scene setting

With changing the DMX values, different colours are created

Address 006 | Address 005 | Address 004 | Address 003 | Address 002 | Address 001

000 | 000 | 000 | 255 | 255 | 255

Start address: 1

Start address: 1

Start address: 4

Address 001 | Address 002 | Address 003

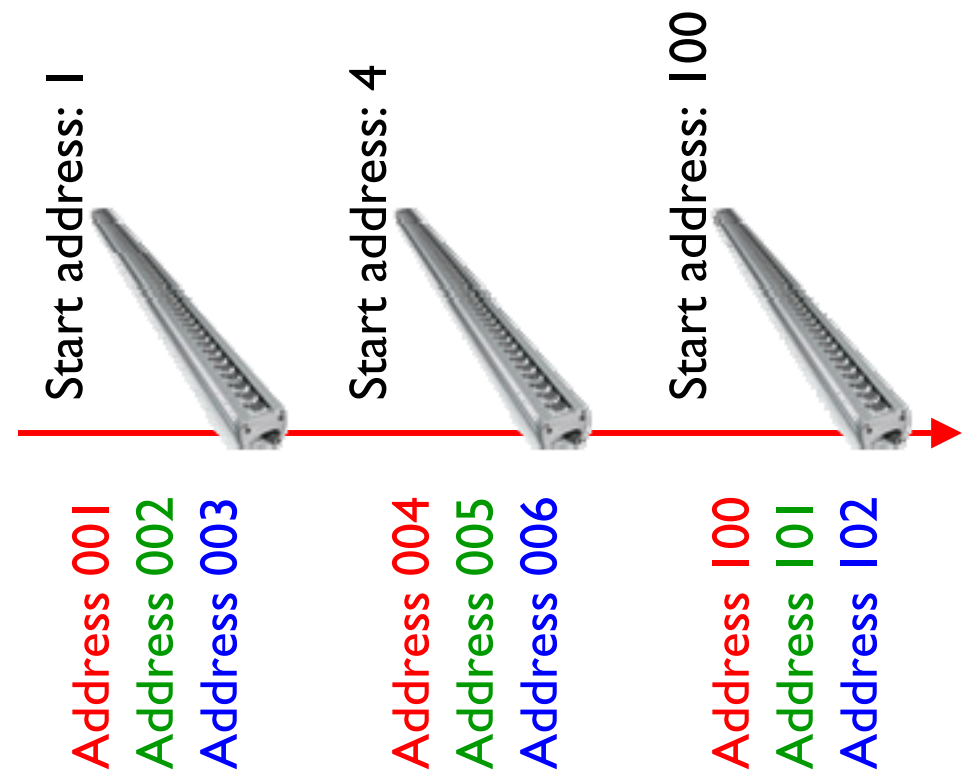Address 001 | Address 002 | Address 003

Address 004 | Address 005 | Address 006

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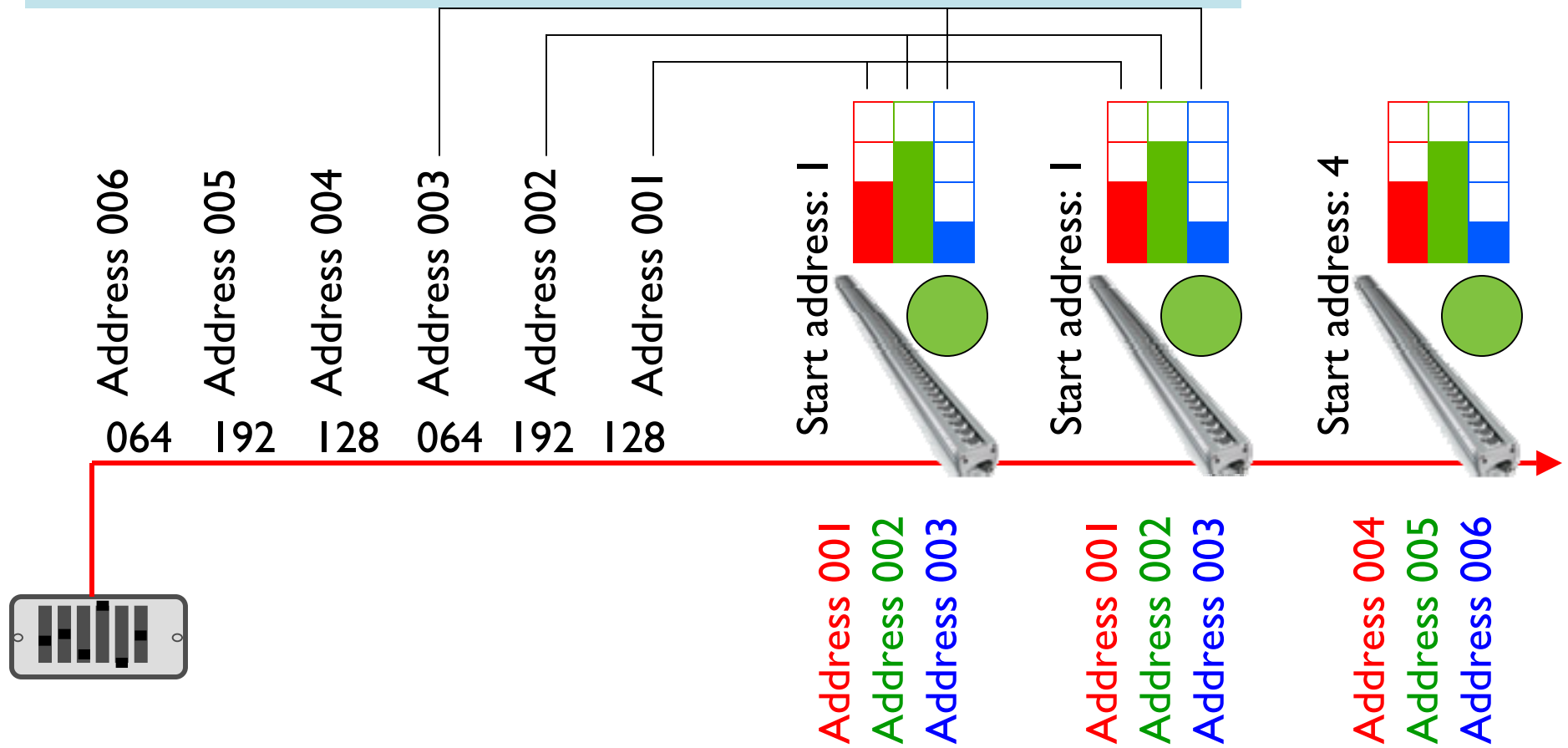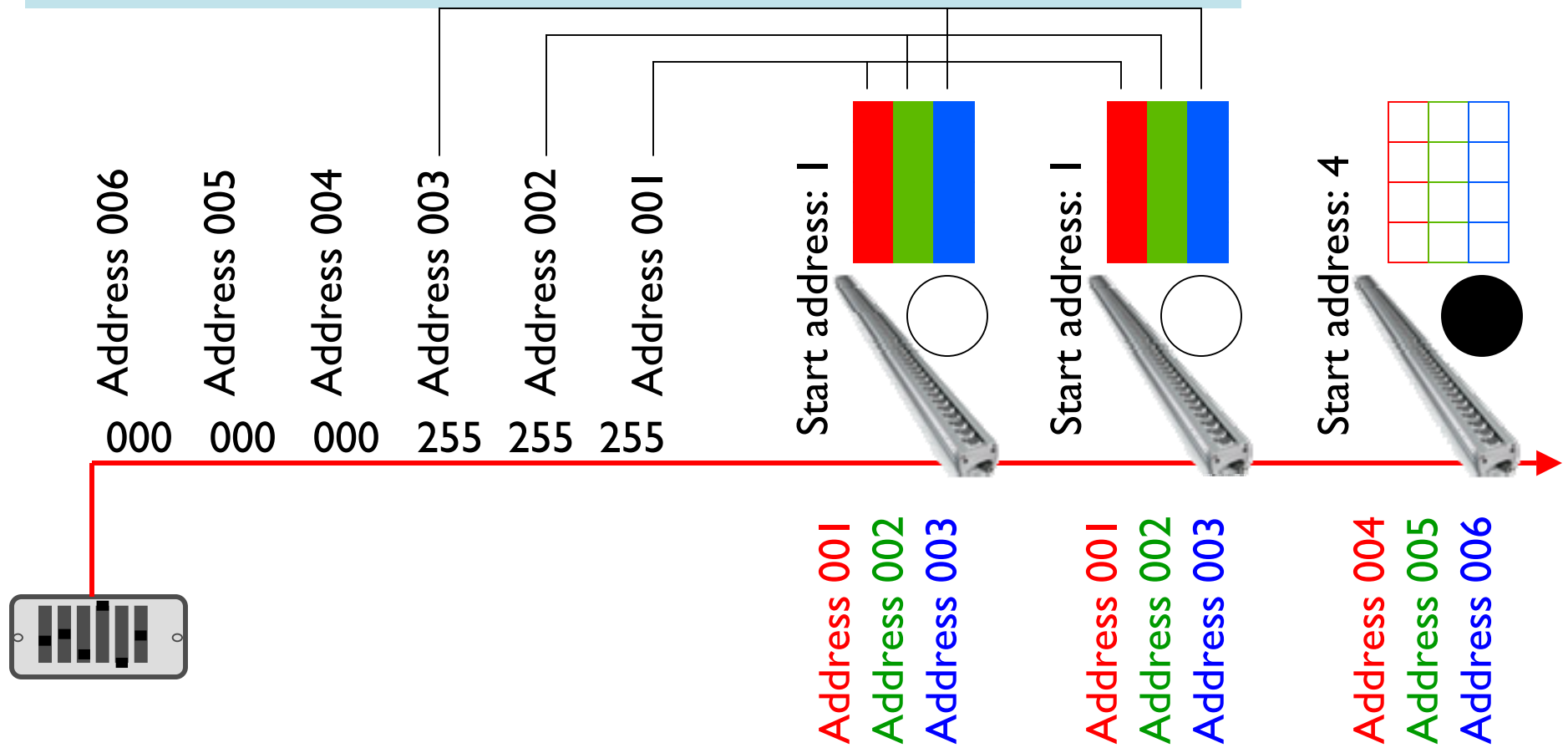
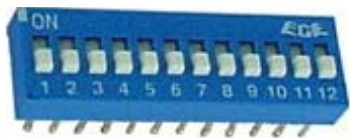# The DMX signal in scene setting

Note: luminaires with the same address will always react the same!

Address 006 — 128
Address 005 — 255
Address 004 — 128
Address 003 — 000
Address 002 — 255
Address 001 — 064

Start address: 1
Start address: 1
Start address: 4

Address 001
Address 002
Address 003

Address 001
Address 002
Address 003

Address 004
Address 005
Address 006
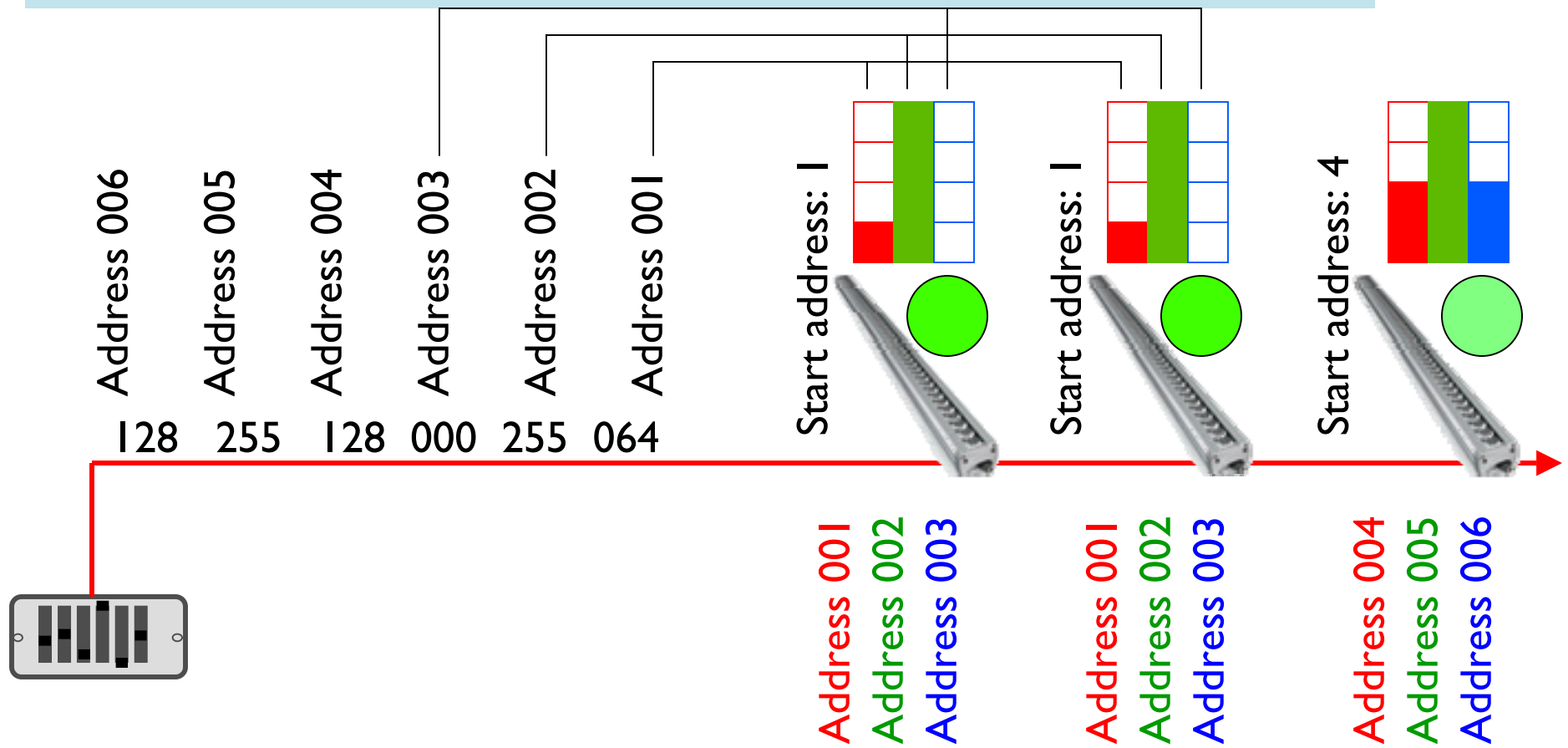
Addressing luminaires

How a start address should be changed depends on the luminaire.

Start address: 1

Start address: 4

Start address: 100

Address 001
Address 002
Address 003

Address 004
Address 005
Address 006
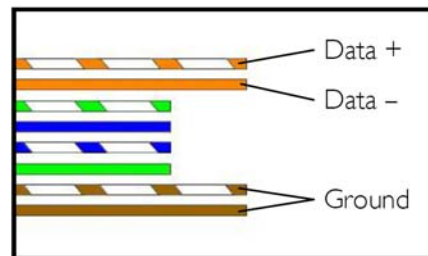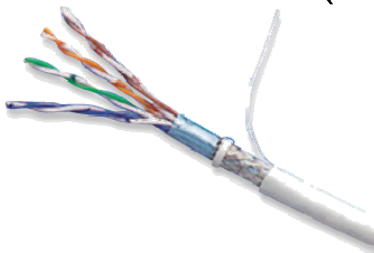
Address 100
Address 101
Address 102

The DMX cable explained

A good DMX control cable is a RS485 ''shielded twisted pair''
This exist of 3 connections; 2 signals and a ground (GND).

Shield = GND

Twisted pair

Data (+) **Data (-)**
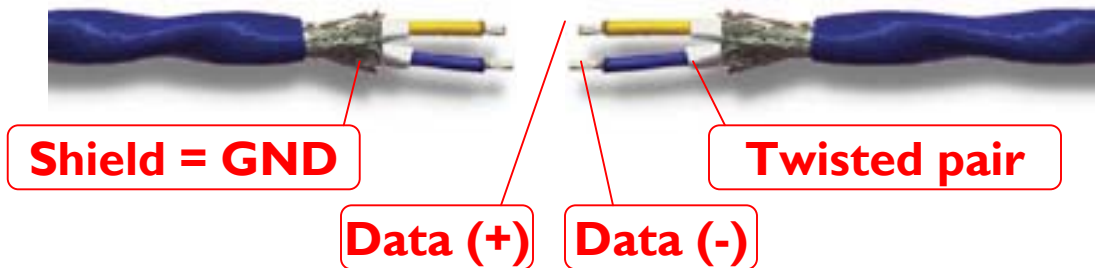
Shielded CAT.5 (or higher) cable can also be used.

Data +

Data –

Ground

CAT.5	S/UTP, F/UTP SF/UTP
CAT.6	U/UTP, S/FTP, S/STP
CAT.7	S/FTP, S/STP

DMX cable
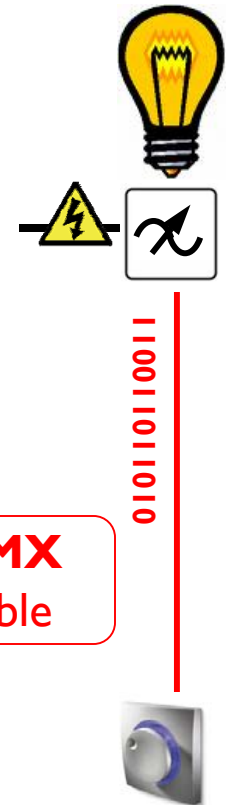
The data (+) and data (-) signal create the actual DMX signal
Ground must be connected for reference, and to prevent interference.

The DMX connector explained

Preferred DMX connectors are RJ45

PIN 1	DATA +
PIN 2	DATA -
PIN 3	
PIN 4	
PIN 5	
PIN 6	
PIN 7	GND
PIN 8	GND

and Neutrik XLR 5 pin

PIN 1	GND
PIN 2	DATA -
PIN 3	DATA +
PIN 4	
PIN 5	

DMX
cable
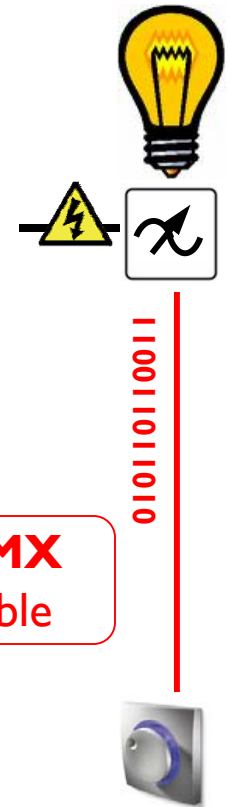
XLR make stronger connections and are suitable for thicker cables
(male for incoming signal, female for outgoing signal)

DMX topology

Topology with DMX is serial (total DMX length <300m)

serial ✔

DMX topology

Topology with DMX is serial (total DMX length <300m)

parallel X
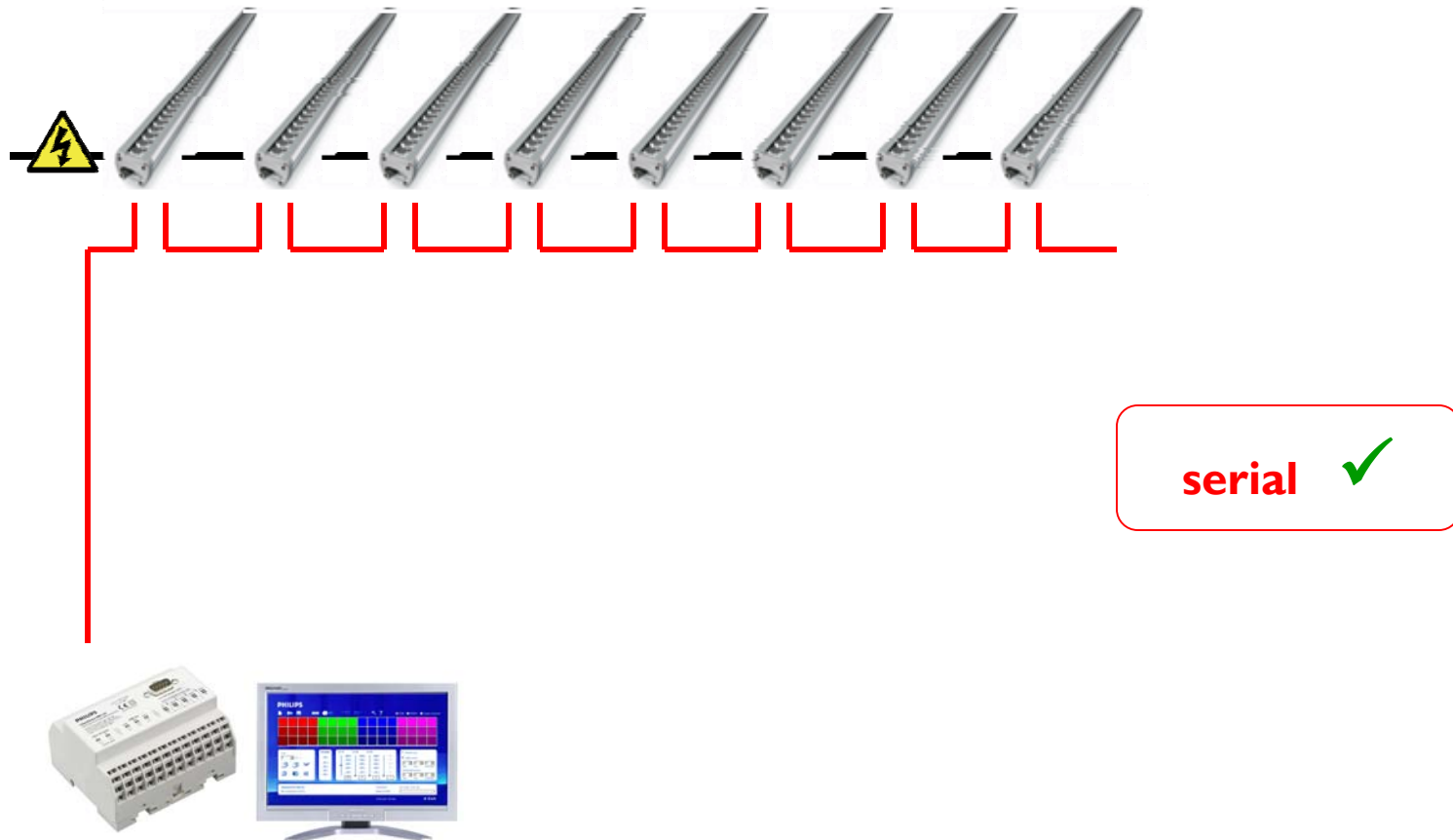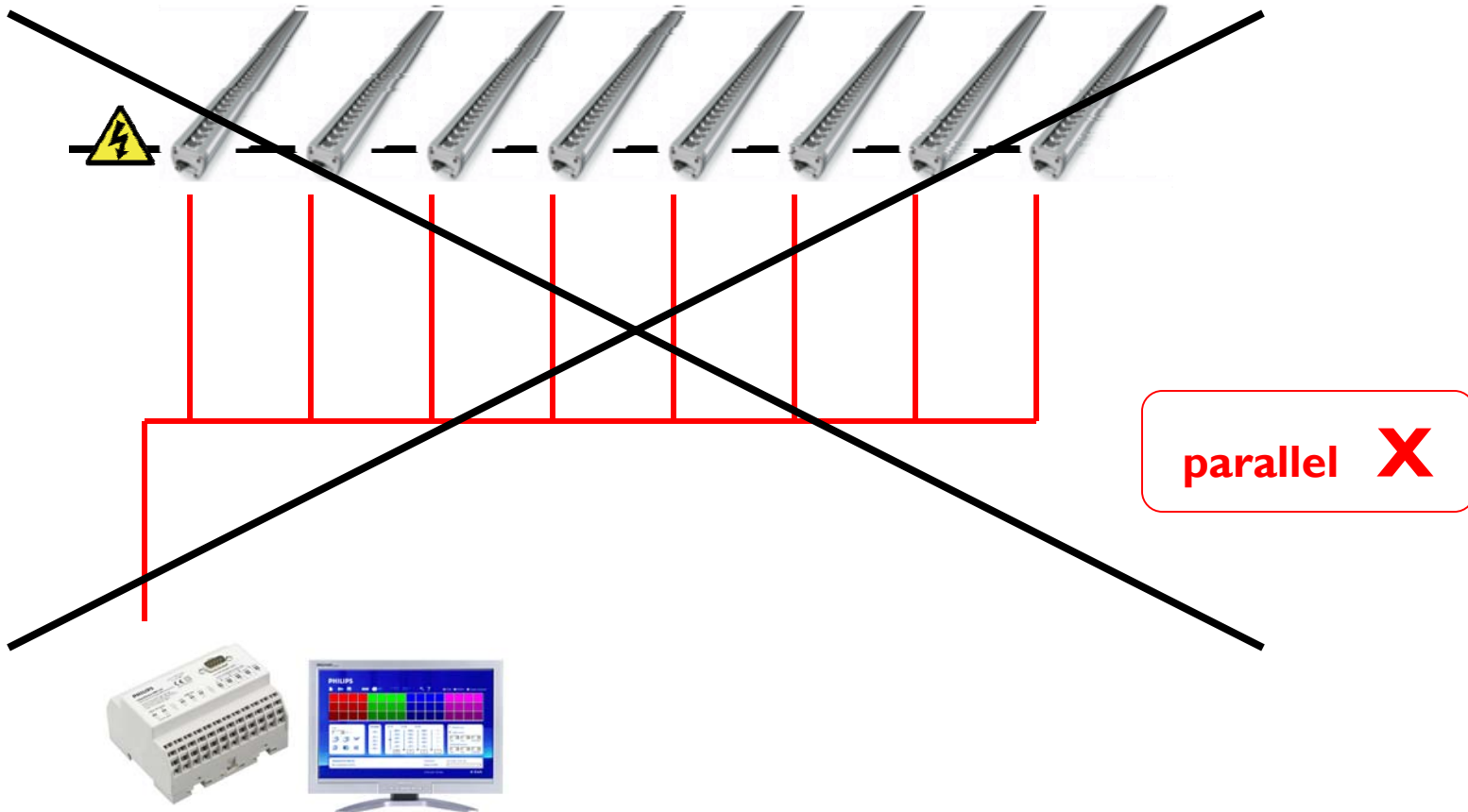
DMX topology

Notes:

- It is possible to split a DMX line;
  this can be done using additional hardware: a DMX-Splitter.

- Every DMX luminaire consumes "DMX energy"
  Maximum 30 DMX devices can be connected to one DMX line.
  After this the signal needs to be boosted with a DMX-Booster

The "4 way optosplitter" splits and boost the DMX signal.

DMX topology

max. 30 pcs

max. 30 pcs

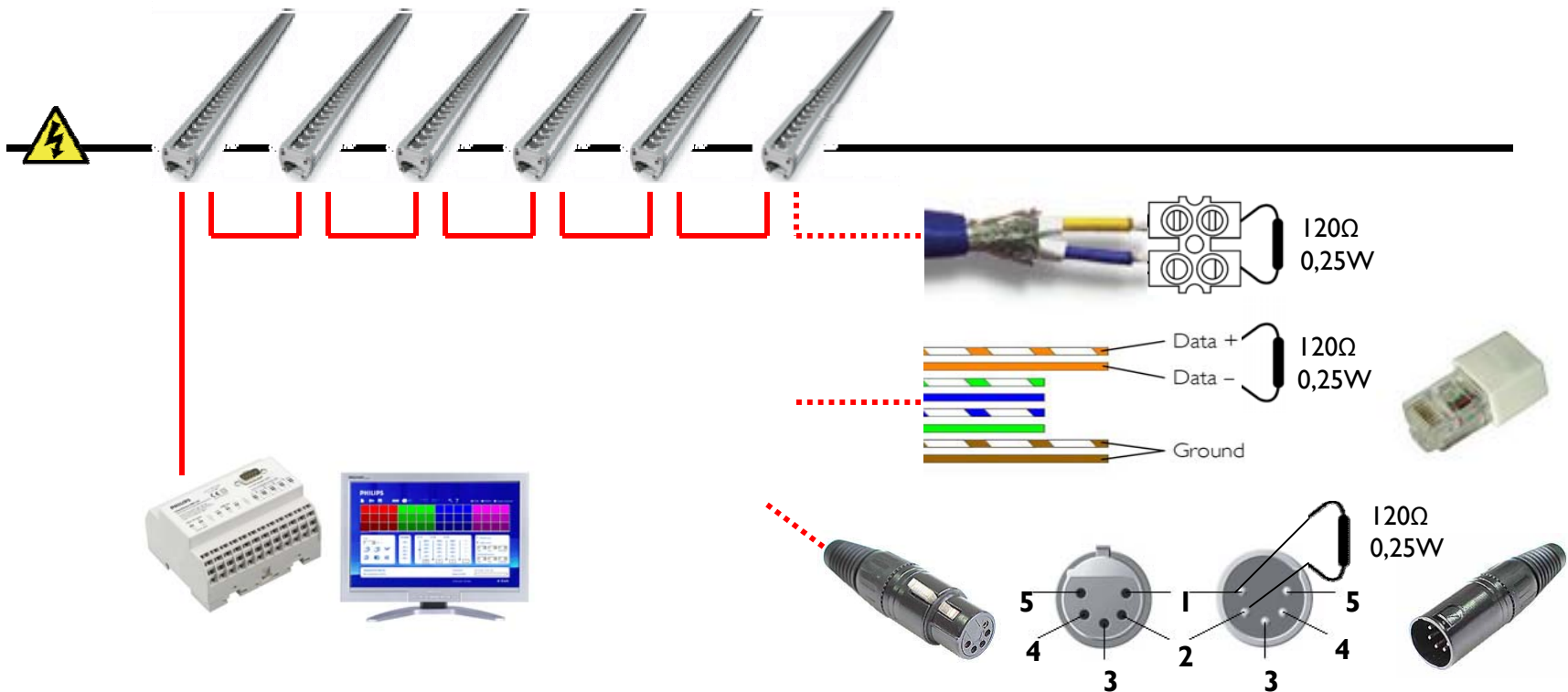**max. 30 pcs**

max. 30 pcs

Splitted & Boosted Signal ✓
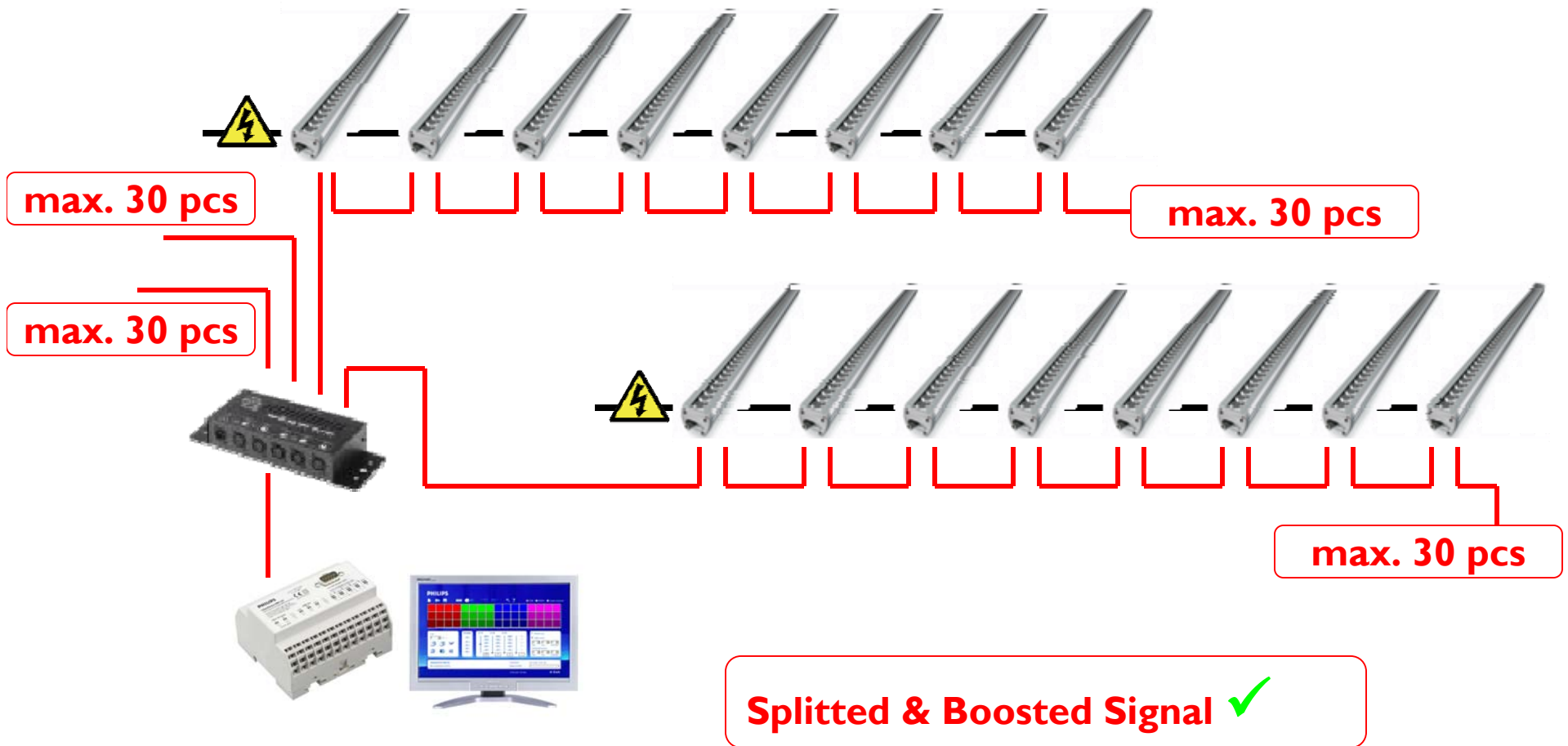
DMX termination

To create a stable DMX signal the end of each DMX line should be "terminated" with a 120Ω resistor

This should be mounted between the Data (+) and Data (-) signal

120Ω
0,25W

120Ω
0,25W

Data +
Data –
Ground

120Ω
0,25W

5   1   5
4   2   4
3   3

DMX technical characteristics (1)

Number of units max.	30 (Using boosters: unlimited)
Number of addresses	512 max
Signal level	several hunderds of millivolts
Speed	40 times 512 values / second
	+/- 250 kbaud
Termination	end of the line, 120 Ohm
Cable length max.	500m, (Using boosters: unlimited)
Cable type	Shielded twisted pair 100-120 Ohm
	Cat.5 S/UPT, F/UTP, SF/UTP
	Cat.6 U/FTP, S/FTP, S/STP
	Cat.7 S/FTP, S/STP
Cable topology	serial (line)
Termination	120 Ohm
Safety	DMX is SELV

DMX technical characteristics (2)

- A DMX system contains one controller (transmitter) and receiver(s)
- Information is transferred by modulating the two signal wires in opposite way. Ground is needed as reference
- An receiver has to be given an address. This is a number between 1 and 512. This address cannot be changed via the DMX connection
- DMX is based on RS485 communication. RS485 is two way communication, this is not implemented in DMX (one way only)
- DMX is invented to replace a multiplexed analog system
- In DMX communication there is no address info. The receiver counts the messages
- Random addressing is not possible. Addresses cannot be left out.
- A DMX value can mean anything, depending on receiver. For luminaires with intensity only most often a linear intensity curve is used.
- Standard: "E1.11, USITT DMX512-A", maintained by ESTA

Summary "Introduction to DMX"

Luminaire settings:
DMX address (start address)

Start address 004
Address 004
Address 005
Address 006

-terminator
-max. 30 pcs

DMX signal: continuous stream of 512 values
Each value (0-255) represents an intensity (0-100%)
DMX address 1, 1st value, (i.e. "128" -> int = 50%)
DMX address 2, 2nd value (i.e. "194" -> int = 75%)
etc.

Booster:+
4x30pcs
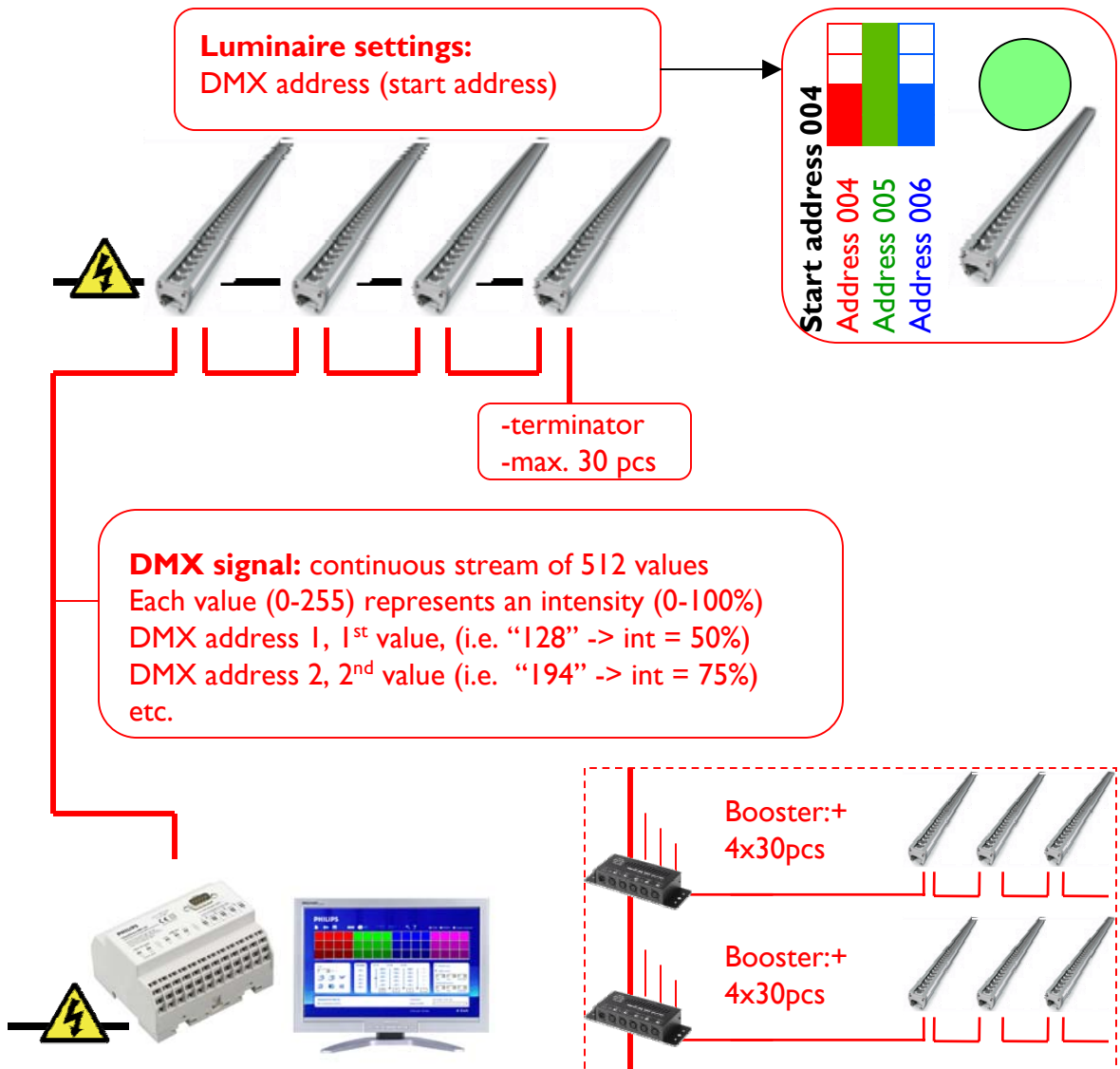
Booster:+
4x30pcs

512 addresses
(i.e. 170x individual RGB)

max 30 DMX devices

Unlimited DMX devices using boosters

Serial topology

Special DMX cable
(shielded twisted pair 120Ω)

Commissioning:
depends on luminaire / controller

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