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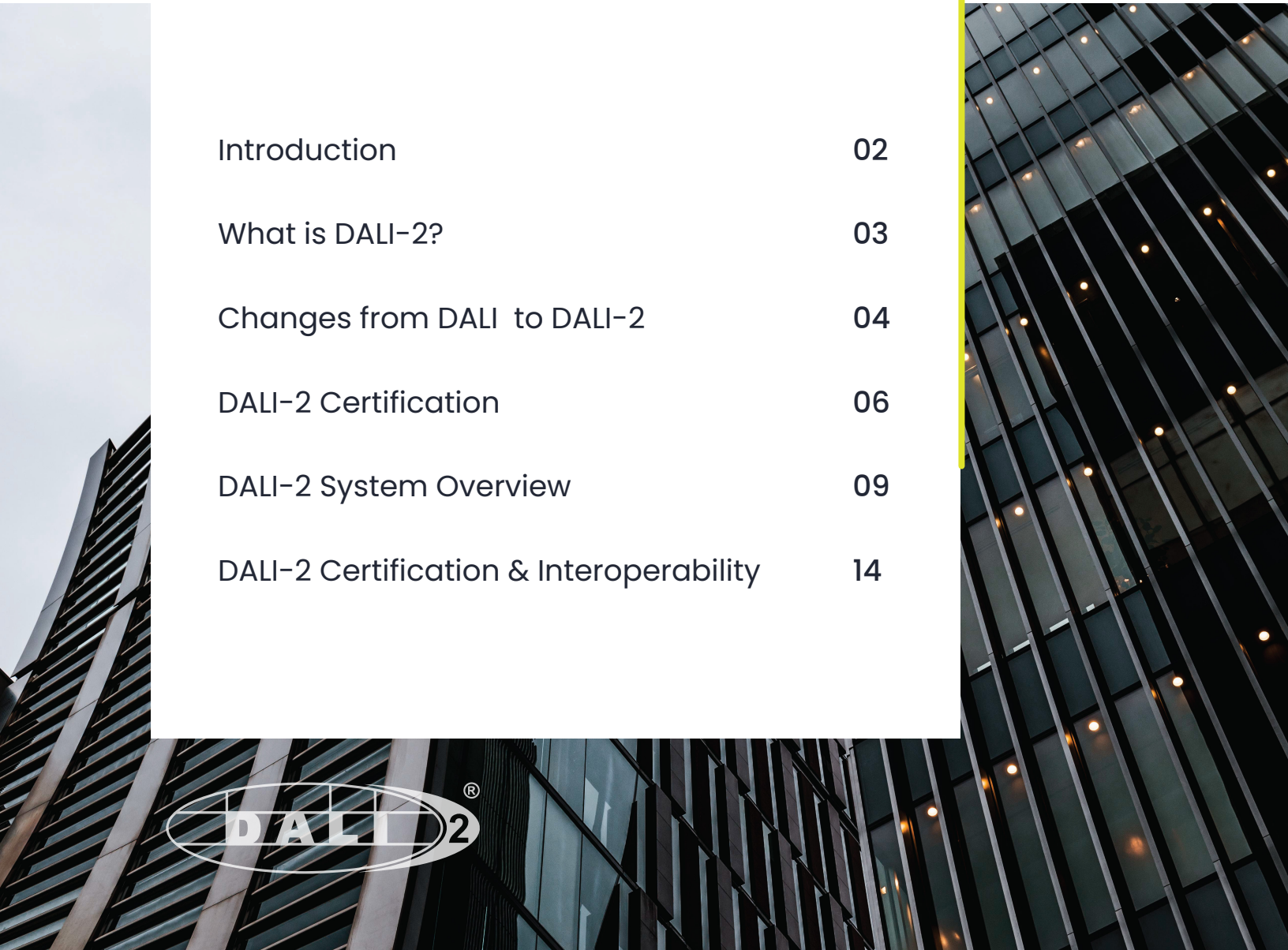
Ebook

DALI 2.0



The **Digital Addressable Lighting Interface (DALI)** is a two-way lighting control protocol first released in the early 1990s. DALI was created to make commercial lighting efficient by providing central control over fixtures.

Known for interoperability and seamless product integration, DALI was established as a successor for 1-10 V/0–10 V lighting control systems. Since its inception, DALI has undergone numerous revisions, and the latest version is DALI-2, otherwise known as version 2 of the DALI standard IEC 62386.

Advantages of **DALI**

- Interoperability
- Future-proof and flexible
- Extend the lifespan of a lighting system
- Less wiring needed
- Enables the creation of multiple groups
- Logarithmic dimming behaviour – matching the eye's sensitivity
- High noise immunity
- Faster and more efficient
- Bi-directional data flow
- Remote access and ability to configure
- Simple and quick installation

What is **DALI-2**

DALI-2 is the latest version of the DALI protocol. This updated version comes with new commands and features. DALI-1 had only control gear, whereas DALI-2 comprises control devices like application controllers and input devices (e.g., sensors) and bus power supplies. DALI-2 primarily focuses on the interoperability of products from different dealers. The certification program ensures the compatibility of products with the relevant specifications.

IEC 62386 Standard

Part 101: General requirements- system components

Part 102: General requirements- control gear

Part 2xx: Particular requirements of control gear

Published

Part 201: Fluorescent lamps

Part 202: Self-contained emergency lighting

Part 203: Discharge lamps (excluding fluorescent lamps)

Part 204: Low voltage halogen lamps

Part 205: Supply voltage controller for incandescent lamps

Part 206: Conversion from digital signal into DC voltage

Part 207: LED modules

Part 208: Switching function

Part 209: Colour control

Part 104: General requirements- Wireless and alternative wired systems

Part 105: General requirements – firmware update

DiiA publication (in preparation for IEC)

Part 150: General requirements – AUX power supply

Published

Part 216: Load referencing

Part 217: Thermal gear protection

Part 218: Dimming curve selection

Part 220: Centrally-supplied emergency operation

Part 221: Load shedding

Part 222: Thermal lamp protection

Part 224: Integrated light source

DiiA publications (in preparations for IEC)

Part 250: Integrated Bus Power Supply

Part 251: Luminaire Data(Memory Bank 1 Extension)

Part 252: Energy Data

Part 253: Diagnostics & Maintenance Data

Part 103: General requirements- control devices

Part 3xx Particular requirements for control/input devices

Published:

Part 301: Push buttons

Part 302: Absolute input devices

Part 303: Occupancy sensors

Part 304 Light Sensors

Part 332: Feedback

Part 333: Manual configuration

In progress:

Part 305: Colour sensor

Part 306: General-purpose sensor

DiiA publications (in preparations for IEC)

Part 351: Luminaire-mounted control devices

The DALI Alliance creates DALI-2 tests based on individual Parts of IEC 62386, as well as DiiA specifications, enabling DALI-2 certification

Advantages of **DALI-2**

- Simpler wiring – one line for lighting, emergency, switches and sensors
- Endorsed & compliant switch and sensor devices
- Cross manufacture compatibility
- Lower overall costs
- Published under IEC 62386
- Certification of the control system component
- Standardised dimming curve

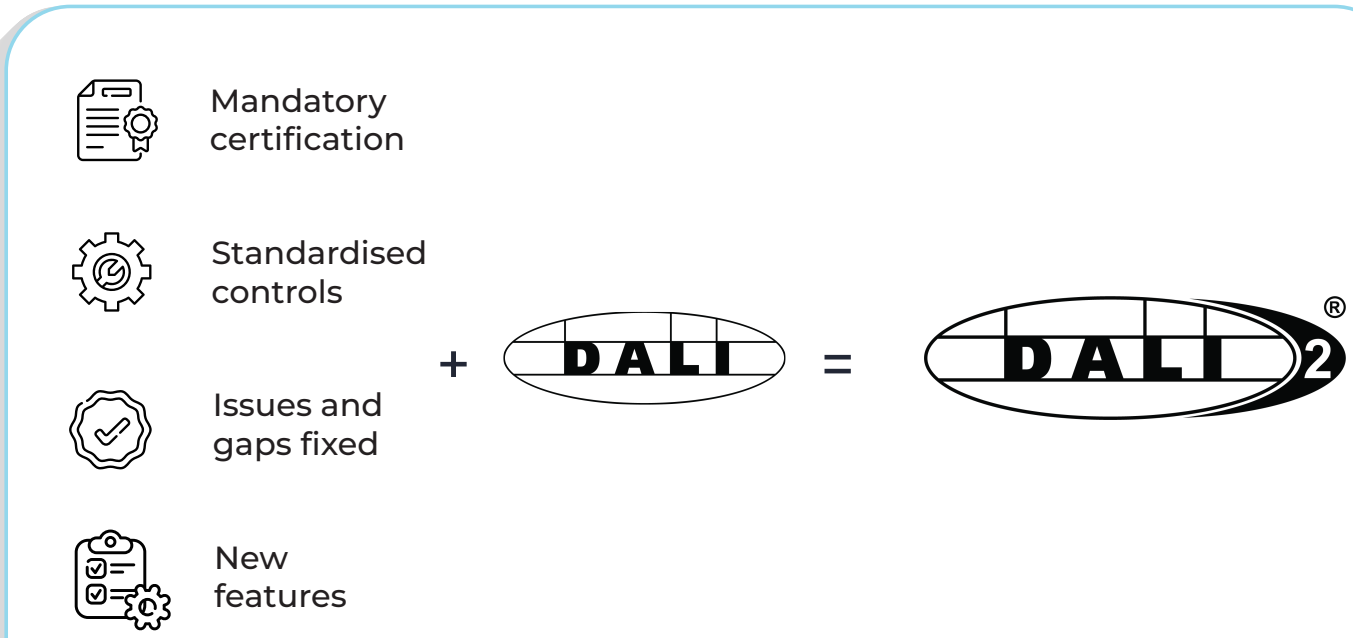
A DALI driver is an LED driver that will accept a DALI or DALI-2 input. It has live & neutral terminals, and two additional terminals marked DA, DA for attaching the DALI bus. The most modern DALI drivers carry the DALI-2 logo, depicting that they have been subjected to the certification process required by the current IEC standard.

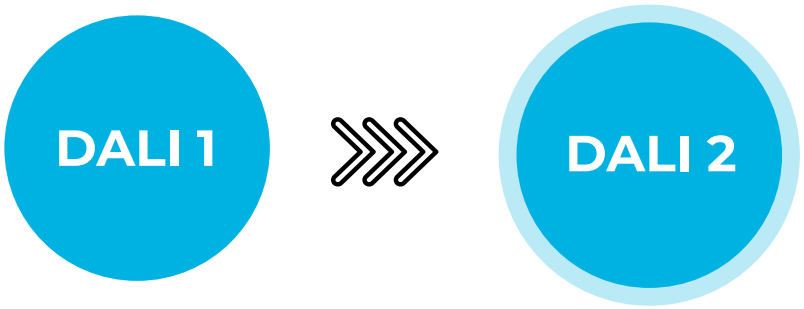
Programming a DALI device varies from one manufacturer to another. Some manufacturers accomplish programming wirelessly but others require a wired connection to the DALI bus.

The first step of DALI device programming is to assign an address to each device in the installation.

Did you know?

Changes from DALI-1 to DALI-2





Improved interoperability

Control gear

Clearer specifications: timing, fading, power-on and start-up
New: extended fade times (0.1s to 16min), bus-powered, Continuous Up/Down commands

Control devices

New to the DALI-2 standard (DALI version-1 is only control gear)

Bus power supplies

Clearer specifications

DALI-1	DALI-2	NOTE
Input		
eD Command	DA24, 24BIT Command	Standardised replacement for eD
Class 3 Light Sensor Class 4 Motion Sensor Class 5 Manual Control Unit	Instance type 4(Light Sensor, IEC 62386 -304) Instance type 3 (Motion Sensor,IEC 62386 -303) Instance type 1 (Manual Control Unit, IEC 62386 -301)	Input devices
Central Unit		
Multi Master System	Introduction of the application controller	Brain of the communication
Output Gear	New commands/features:	
	Save persistent variables	Persistent variables are stored in a non-volatile memory / storage area.
	Set operating mode (DTR0)	Allows configuring the operating mode.
	Reset memory bank (DTR0)	Resets the memory bank to its default values.
	Identify device	Identifies (localises) a device

New commands not supported	Set extended fade time (DTR0)	Allows to set the "extended fade-time"
	Go to last active level	IAP (Indirect Arc Power command), Last active level will be called.
	Query operating mode	Query of the operating mode
	Query light source type	Information to the connected light source
	Query next device type	Readout of the supported device types / functions
	Query extended fade time	Readout of the extended fade-time
	Query control gear failure	Detailed error inquiry

Addresses, Groups and Scenes

DALI-1	DALI-2	Notes
64	64	Addresses for control gear
64	64	Addresses for control devices
16	16	Scenes for control gear
16	16	Groups for control gear
16	32	Groups for control devices
-	32	Groups for instances of input devices

DALI-2 Certification

The DALI-2 certification is based on DALI-2 test specifications created by DiiA. They are derived either from the most significant parts of IEC 62386, the international DALI standard, or from new specifications written by DiiA.

Requirements & Rules

- Products should successfully complete the DALI-2 certification process
- Upon successful completion, these products qualify to use the DALI-2 trademarks
- Certified products can carry the DALI-2 trademarks
- Only DiiA members can certify their DALI-2 products

Mandatory certification

- Control system can now be certified
- Tighter control on the use of the DALI-2 trademark
- Better definition and certification of DALI power supply

Standardised controls

- Introduced control devices as part 103 of IEC62386
- Defined single master and multi-master control
- Standards for sensor controls and switches
- Definition of an application controller

Fixing issues and gaps related to previous version

- Restructuring of specification, dedicated system description
- Error corrections (particularly in regards to the test-procedures)
- More detailed specifications, leading to less risks of misinterpretations
- Reduced risk for malfunctions due to more precise specification of electrical tolerances

New features

- Introduced control devices as part 103 of IEC62386
- Defined single master and multi-master control
- Standards for sensor controls and switches
- Definition of an application controller

D4i Certification

D4i is defined as the DALI standard for intelligent, IoT-ready luminaires. It is an extension of DALI 2- certification or, in other words DALI 2 is the communication standard, and D4i is its features. This certification makes mounting sensors and communication devices on luminaires with special control and power requirements. DALI-2 exists without D4i, but D4i cannot exist without DALI-2.

D4i vs DALI-2

D4i certification is an extension of DALI-2 certification for LED drivers and control devices.
Products that are DALI-2 and have a certain set of features are called D4i products.
Drivers and controls that have received D4i certification also have DALI-2 certification.
These goods may optionally display the DALI-2 or D4i logos, or both.

DiiA Specifications

Built on the worldwide standard IEC 62386, the DALI Alliance (DiiA) creates and updates new specifications that describe additional DALI capabilities and functionalities. Both DALI Alliance members and non-members have free access to the DiiA Specifications.

This is an interim version that will be updated at a future date. Visit www.dali-alliance.org

The DiiA Specifications listed can be downloaded	Published version	Certification Available
Power Supply Specifications		
DALI Part 150- Aux Power Supply	Version 11, October 2019	✓
DALI Part 250- Integrated Bus Power	Version 11, October 2019	✓
Data Specifications for LED Devices		
DALI Part 251 Memory Bank 1 Extension (Luminaire Data)	Version 11, October 2019	✓
DALI Part 252 Energy Reporting (Energy Data)	Version 11, October 2019	✓
DALI Part 253- Diagnostics & Maintenance(Diagnostics Data)	Version 11, October 2019	✓
Specifications for Control Devices		
DALI Part 351- Luminaire Mounted Control Devices	Version 11, October 2019	✓

INTERESTING FACTS!

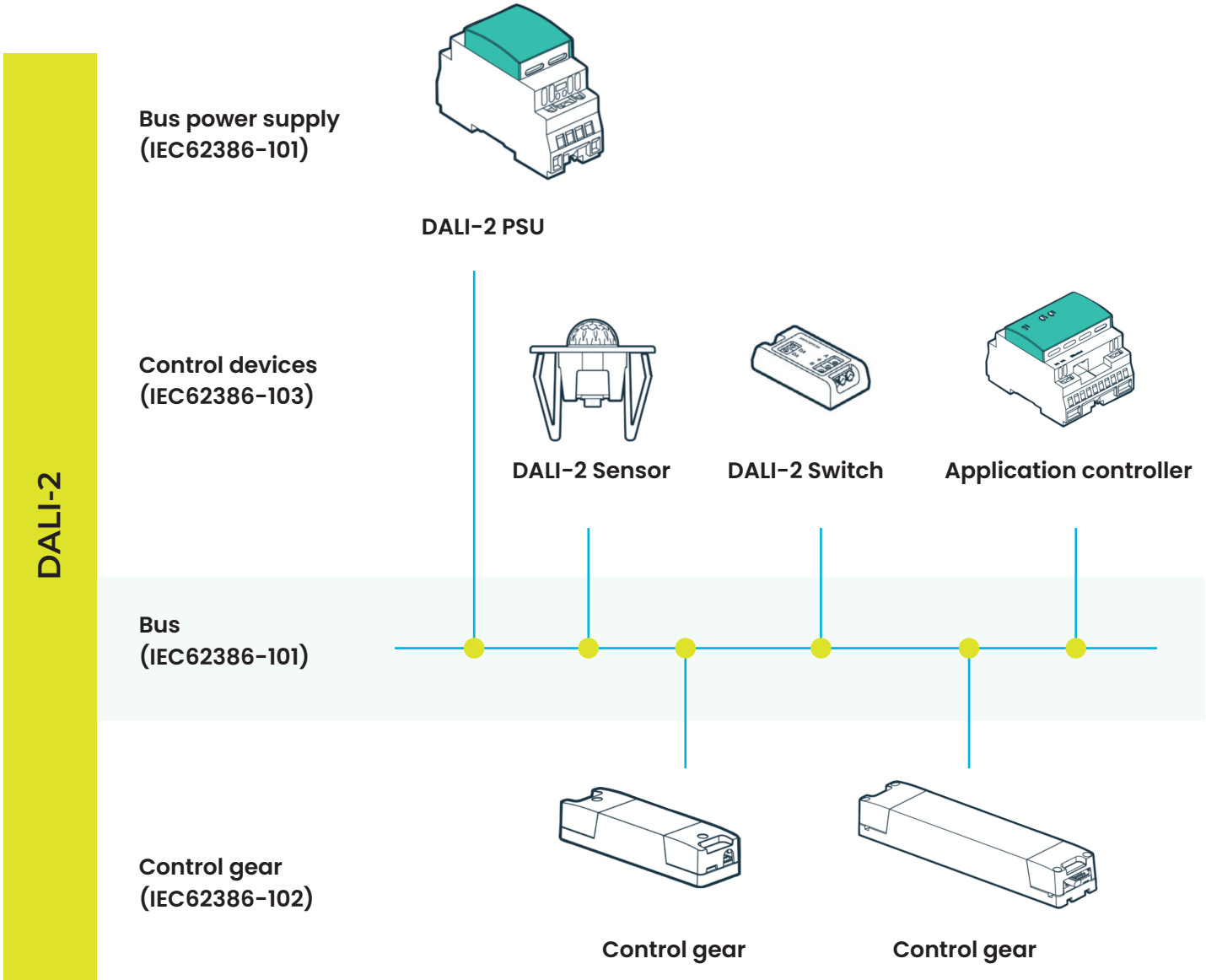
Common misconceptions	Truth
DALI is a European Standard	No! IEC 62386 is a world-wide standard
DALI is difficult to program (e.g. laptops needed, 2-man job, difficult to replace faulty products)	Out-of-box operation, with no programming, gives at least the level of operation obtained from 0-10V. Programming, if required, varies between manufacturers
Products are not available	The choice is increasing
The drivers and controls need to be on separate buses	No – they are designed to allow connection to the same DALI bus
DALI is expensive to install	No – it is likely to be lower cost than 0-10V installations due to less wiring required

DALI-2
System Overview

DALI-2 comprises control devices, control gears, DALI bus and bus power supply. Individual or integrated with an existing device, the system should have a bus power supply. In the old DALI system, the input devices used to communicate with the control gear directly. In DALI-2 the new application controller processes the commands and sends them to the control gears (LED drivers).

DALI-2 System Components

Now with sensors and switches on the same bus



The main DALI-2 product types required for a complete lighting-control system and their function are:

Control gear
(e.g., LED drivers)-
Provide power to
light sources

Control devices–
which have two main types:

Application controllers-
Use information, make decisions
and send commands to the control gear

Input devices-
Sensors (e.g., light, occupancy)
and devices to enable user input

Bus power supplies-
Provide power required
for DALI communication

A DALI-2 product can contain more than one product type e.g., an application controller with integrated bus power supply.

DALI Bus

The bus is the core of DALI. It is a pair of wires that act as a carrier of digital control signals from input devices to an application controller. According to the programmed rules, the application control generates signals for the output devices. A DALI bus uses standard 2-core cable (1.5mm^2) wires and carries both DALI power and data on the same pair of wires. The maximum distance between the devices or the cabling length is 300m and free topology is allowed and it is not necessary to observe the polarity of wires.

DALI-2 For Control Gear And Bus Power Supplies

Property	Benefit
Clearer specification, including bus timing and bus power supplies	Improved interoperability
Requirement of polarity insensitivity	Easier installation
Bus powered units	Less wiring
Multiple logical units	More cost-effective products
Extended fade time, 100ms to 16minutes	Increased comfort & flexibility
Manufacturer specific operating modes	Improved interoperability & flexibility
Query light source type	Easier maintenance

Control Gear

Control gears are usually connected to lamps directly to power them. In DALI-2, each DALI subnet can have 64 control gear, and the control gear's general requirements are explained in part 102 of the IEC 62386 standard. DiiA has broadened the DALI-2 certification program to encompass control gear that functions as switches and relays and implements Part 208 of the DALI-2 certification scheme.

Part 2xx Explains Particular Requirements of Control Gear

Part 202- Self Contained Emergency Lighting

Emergency lighting, which provides light when the mains supply fails, is a critical feature that is mandated by various regulations. "Self-contained" means that the battery – which provides power during an emergency – is inside, or placed next to, the luminaire.

In many countries, there is a legal requirement for periodic testing of emergency lighting. DALI enables self-contained emergency tests to be automated, triggered by DALI commands or by an optional timer.

Emergency control gear must implement both a function test and a duration test. The function test is a quick test of the battery, charging circuit, driver/relay and lamp, while the duration test ensures that the battery will be able to operate the lamp for the full rated duration (for example 1 hour or 3 hours)

Part 209-Colour Control

DALI enables several alternative methods—known as colour types—that can be used to control the colour output of light sources.

The main colour types are now all included in the DALI-2 certification program, using tests developed by the DALI Alliance.

Part 251-Luminaire Data

Luminaire information is typically encoded into the LED driver by the luminaire manufacturer. Data includes:

- luminaire supply power & voltage
- light output
- CCT & CRI
- light distribution
- luminaire colour, and more.

Part 252-Energy Data

The LED driver can report operational data including:

- Active energy/power
- Apparent energy/power
- Load-side energy/power

Part 253-Diagnostic and Maintenance Data

The LED driver can report operational data including:

- Failure conditions for control gear and lamps, including counters.
- Control gear information: Operating time, start counter, supply voltage and frequency, power factor, temperature and output current.
- Light source information: Operating voltage, current, temperature, light source start counter, light source on time.

Control Devices (Part 103)

Control devices can be simple devices, or complex gateways interfacing with other systems. DALI 2 includes control devices for the first time and the benefits are:

- Application controllers and Input devices defined
- Single-masters and multi-masters allowed
- Event priorities defined
- Separate addressing & grouping from control gear

Application Controllers

- The 'brain' of the system
- Gathers information, analyse and make decisions and then sending commands to the control gear

Input Devices

- Devices that provide information to the system
- Examples include push-buttons, sliders, occupancy sensors, and light sensors
- Can be very simple devices, or could be complex gateways interfacing with other systems

Application Controllers

Application controllers are known as the brain of the DALI system. They gather information from various sources like control gears (LED drivers), input devices, other application controllers, or external devices/ buses/ systems and process this information to make required decisions. Only application controllers are eligible to send the commands to the control gear. Sometimes, the application controls are integrated with the DALI bus power supply. The explanation is detailed in part 103 of IEC 62386 standard.

Application controllers comes in two variants; single master, and multi-masters.

Single Master

- Control devices that cannot share the DALI bus with other masters, i.e., only one control device is allowed on the DALI bus
- May allow polling of input devices, or checking status of control gear
- Receiver is not necessary

Example

Occupancy sensor broadcasting levels to the control gear

Multi Masters

- Control devices that capable of sharing the DALI bus with other control devices, i.e., more than one controller can be used in the same bus
- It uses a short address for the individual controlling
- Support both polled and event driven methods of obtaining information from input devices

Example

Controller driving two DALI buses

Input Devices

Input devices provide user-derived and environmental information to the lighting control system and they are multi-master. It consists of sensors that cater information for automated control, and devices enabling user inputs thereby allowing occupants to adjust dimming, colour, scene etc.

Four Input Devices are Published in IEC 62386;

- **Push button**
  Part 301
- **Absolute input device**
  Part 301
- **Colour sensor**
  Part 305 (In progress)
- **Occupancy sensor**
  Part 303
- **Light sensor**
  Part 304

Push button Part 301	They can be used for switching and dimming the DALI luminaires manually allowing the users to modify the lighting level to suit demands. Defined in part 301 of IEC 62386 standard
Absolute input device Part 301	Simple on/off switches, or multi-position switches, Slider or rotary controls
Occupancy sensor Part 301	Movement or presence type sensor Events can be triggered on state change to: occupied, vacant, movement, no movement
Light sensor Part 304	Light sensor measures illuminance level Programmable hysteresis to minimise bus traffic Optional periodic events reporting the illuminance level

Bus Power Supplies

Each DALI-2 system requires a standalone bus power supply or the one integrated with another device (e.g. an application controller). Bus power supplies provide typically 16V and up to 250mA current to power devices connected to the bus. The requirements for bus power supplies are defined in the Part 101 of IEC 62386 standard.

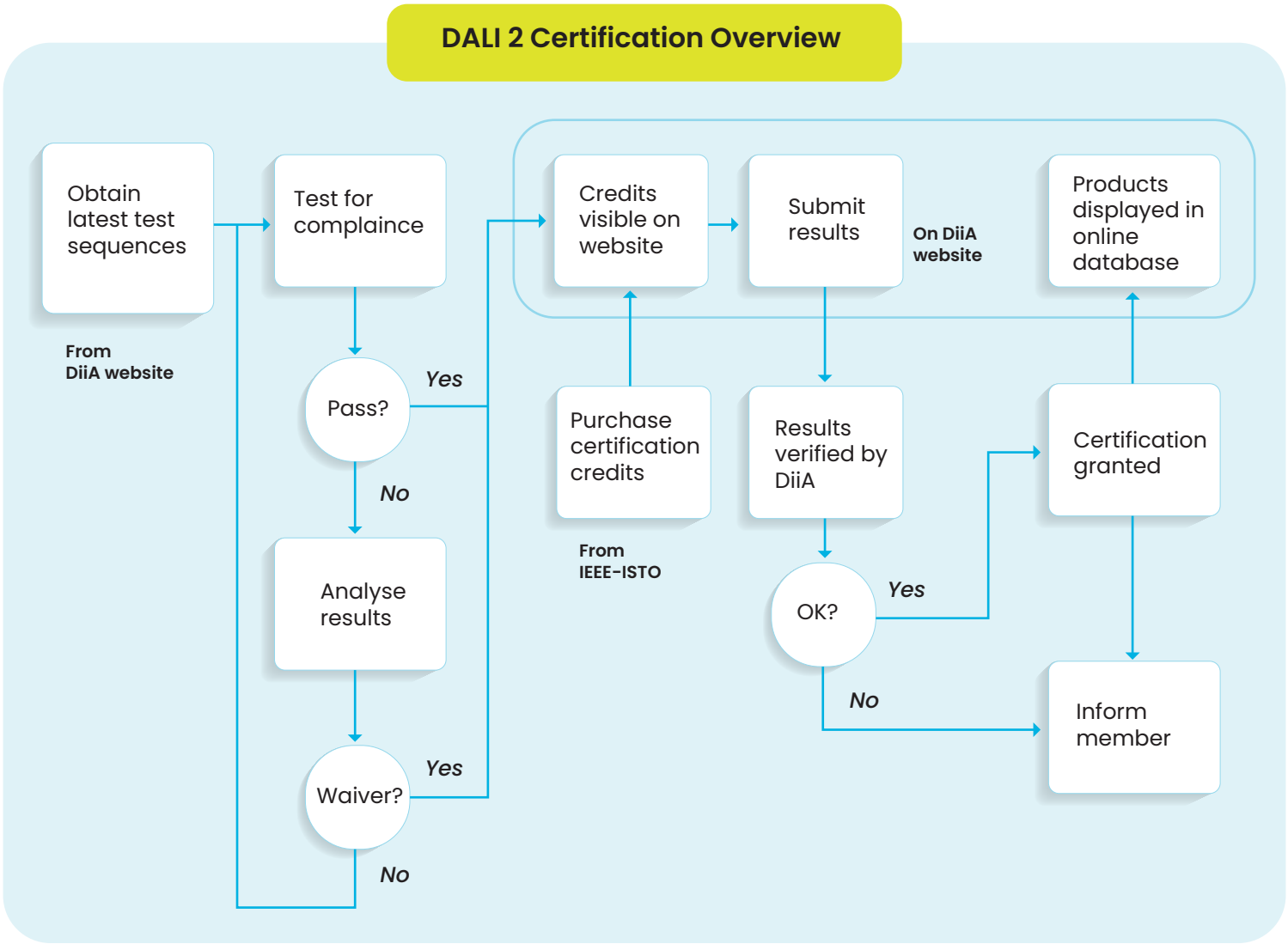
Read more https://www.dali-alliance.org/dali/standards.html

Cabling And Bus Power Supplies

- The DALI bus carries DALI power and data on the same pair of wires, typically using standard 2-core cable (1.5 mm²)
- The polarity of the wires does not have to be observed, and free wiring topology is allowed
- The maximum cabling length (the distance between the furthest-apart devices) is 300m
- Each DALI-2 system requires a bus power supply, which can be a standalone device or integrated with another device (e.g. an application controller)
- Bus power supplies provide typically 16V and up to 250mA to provide power to devices connected to the bus

DALI-2 Certification & Interoperability

For the future development of smart lighting, a common standard and interoperability is the need of the hour. DALI-2 ensures multi-vendor interoperability through testing, certification, and registration with trademark use. The certification relies upon the DALI-2 test specifications created by DiiA, which are derived either from the relevant parts of IEC 62386, the international DALI standard or from new specifications written by DiiA.



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