

DALI-2: Smart lighting control and interoperability

Scott Wade, Technical & Certification Manager

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Agenda

- **Introduction, key facts & benefits**
- **DALI – common misconceptions and comparisons with other protocols**
- **Major changes from DALI version-1 to DALI-2**
- **Compatibility**
- **Certification**
- **IEC 62386**
- **New DiiA specifications – smart luminaires**
- **Outdoor smart luminaire example**
- **Application – emergency lighting**

DALI & DiiA

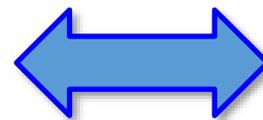


Digital **A**ddressable **L**ighting **I**nterface

- **World-wide standard** for lighting control communications
- Technically managed in the open standard **IEC 62386**
- Driven by Digital Illumination Interface Alliance (DiiA)
- Ensures **interoperability** through **testing, certification** and **registration** with **trademark** use
- **Control, configuration & querying** of devices
- **Individual, group & broadcast addressing** to any DALI device
- DALI and DALI-2 trademarks owned by  Digital Illumination Interface Alliance

DALI – key facts & benefits

- **Technical limits**
 - max. 64+64 addresses per DALI subnet
 - max. 300 m cabling (between furthest-apart devices)
 - max. 250 mA bus power supply
- **Digital benefits**
 - Robust communication
 - Addressing: individual (64+64), groups (16/32) and broadcast (all)
 - Flexible: changes via software
 - Two-way communication (feedback)
- **Cabling benefits**
 - Standard 2-core cable (1.5 mm²)
 - Polarity-free & free wiring topology
 - DALI power and data on same pair of wires



DALI – key facts – basic types of devices

Currently, the standard describes **three basic types** of devices:

- **Control gear**

- These are normally directly connected to the lamp, providing it with power



- **Control devices (two basic types:)**

- Application controllers
- Input devices



- **Bus power supplies**

- Provide typically 16 V, up to 250 mA to power the bus.

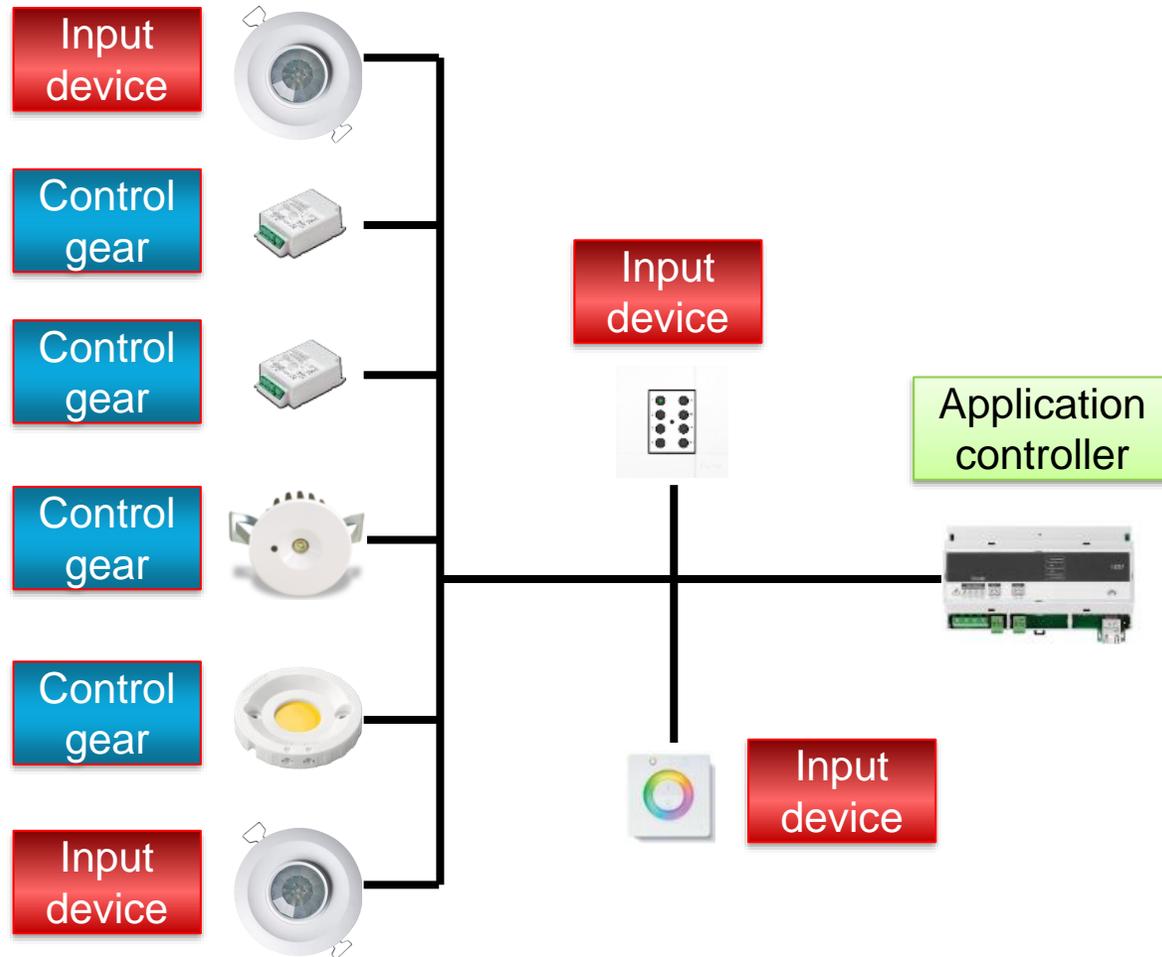


DALI – key facts – control devices

- Control devices are new to the DALI-2 standard (IEC 62386-103). There are two types:
- **Application controllers**
 - The “brains” of the system.
 - Use information from any source, make decisions and can send commands to the control gear.
- **Input devices**
 - Fairly simple devices that provide information to the system.
 - Examples include push-buttons, sliders, occupancy sensors, and light sensors.
- The following page shows **one example of a system** including control devices.



DALI – key facts – example system



- Control gear
- Input devices (control devices)
- Application controller (control device)

Note:

- Systems can contain more than one application controller.
- A bus power supply is required, either separate or integrated with an existing device.

DALI – misconceptions and protocol comparisons

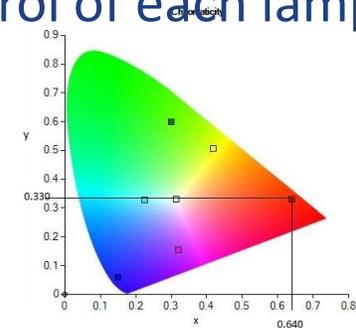
- **“DALI wiring is expensive”**
 - **Actually the opposite is true!** Standard mains cable can be used for the DALI bus – lower cost and easier to obtain than other cable types.
 - This means **existing mains cable can often be re-used for DALI**. For example, if a mains wall-switch is replaced with a DALI push-button panel, it is likely that the existing cable can be disconnected at both ends and re-used for DALI. (Check local wiring regulations.)
 - The **DALI bus pair can be two cores of a multi-core mains cable**. For example, a 5-core cable can be used, with 2 of these cores used for DALI. (Check local wiring regulations.)
- **“DALI is more complicated than 1-10V/0-10V”**
 - **DALI products can operate immediately after installation**, without any configuration (no programming, no network/security keys required, just “out-of-box” operation).
 - The default for new devices is to respond to “broadcast” commands. In this case, all lights will change level together, similar to 1-10V operation.

Comparison with 1-10V (0-10V)

- The same cable used for 1-10V/0-10V lighting control can often be used for DALI, provided the cable length/thickness is within the guidelines. (Check local wiring regulations.)
- With **1-10V**, **separate cable runs must be used** for each group to be controlled separately.
- With **DALI**, **all devices can be connected to the same cable**, and grouping programmed. Groups can even overlap (for example one group for a classroom, another for the whiteboard area of the classroom, and another group for the row of lights near the classroom windows).
- With a digital protocol for lighting, applications such as colour control and emergency lighting testing become straightforward with DALI.

Comparison with DMX512

- DALI is not intended for the fast changes and diverse load types often used for entertainment lighting. However, use of scenes does allow synchronised changes across all connected lights with a single DALI GO TO SCENE command – in a shorter time than it takes to send to 512 DMX channels.
- Unlike DMX that requires a strict daisy-chain (series) connection of the bus, with bus terminators at each end, **DALI bus wiring can be any combination of daisy chain and spurs**, provided the maximum recommended distance between the farthest-apart devices is met.
- DALI allows **more than one “master”** to control the bus, sending commands to the lighting.
- Rather than sending individual levels to separate channels (addresses) as done with DMX, **colour control in DALI** is achieved using a specific colour device type that understands four methods: Tc (colour temperature), xy chromaticity (for precise and repeatable selection of colour), RGBWAF (simpler colour control) and primary-N (individual control of each lamp, or primary).



Comparison with KNX & Bluetooth® mesh

- **KNX**



- Not specific to lighting control. Provides some basic operation for lighting.
- DALI provides lighting specific features, meeting the needs, for example, of emergency lighting testing and reporting.
- KNX can be used as a “backbone” to connect multiple DALI systems into a larger system.

- **Bluetooth® mesh lighting application**

- Some lighting applications are being developed, but these use fixed applications (the decision making part of a lighting controller). This is likely to make it useful for simpler residential applications, but unsuitable for professional/commercial lighting applications.
- Installation of a wireless system is also problematic – there is no certainty that products will be able to communicate due to the dependency on the RF environment and the building construction. Latency in wireless communications can also result in unacceptable delays between operating a push-button and all the lights coming on, for example.

Major changes from DALI version-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 (Amd1)
 - **Control devices:**
 - New to the DALI-2 standard (DALI version-1 is only control gear)
 - **Bus power supplies:**
 - Clearer specifications
 - Tests added
 - Can be DALI-2 certified
- **Increased testing**
- **DALI-2 certification!**



- **See a comparison and download the technical note on the DiiA website:**
www.digitalilluminationinterface.org/dali/comparison.html

Compatibility of DALI version-1 and DALI-2



- **First, look for the DALI or DALI-2 trademarks on products:**
 - Control devices before DALI-2 are proprietary, and are not allowed to use the DALI version-1 trademarks.
 - There were no tests for bus power supplies before DALI-2, so these are not allowed to use the DALI version-1 trademarks.

Situation	Outcome
Using DALI-2 control gear in older systems	<ul style="list-style-type: none">• No problems are expected. DALI-2 is designed for backward compatibility.
Using DALI version-1 control gear with DALI-2 application controllers	<ul style="list-style-type: none">• Check that the DALI version-1 control gear has been successfully tested• No problems are expected, but the DALI version-1 control gear will not have the new DALI-2 features
Using bus power supplies that are not DALI-2 certified	<ul style="list-style-type: none">• There is no certainty that these will work, because there were no tests for bus power supplies before DALI-2
Using control devices that are not DALI-2 certified	<ul style="list-style-type: none">• There are no standards and no tests for control devices before DALI-2• Contact the control device manufacturer for compatibility

DALI-2 Certification

- **Test the product**



- Self-tested using the approved tester and the official test sequence software.
- Alternatively: use a DiiA accredited test-house.

- **Submit product information and test results**

- This is done through the member's DiiA website account.

- **Verification by DiiA**



- Test results and product information is checked.

- **Trademark use:**



- The DALI-2 trademark may be applied to the product and product literature.
- The product is automatically included in the public database.



Certification credits



IEC 62386 Parts

- Many existing IEC 62386 parts for:
 - Control gear
 - Control devices
 - Bus power supplies
- Several IEC parts are in progress



IEC 62386 standard

Red text = DALI-2 versions published

Part 101: General requirements – System components

Part 102: General requirements – Control gear

Part 104: General requirements – Wireless and alternative wired systems **In progress**

Part 103: General requirements – Control devices

Parts 2xx: Particular requirements for control gear

Part 105: General requirements – Firmware update **In progress**

Parts 3xx: Particular requirements for control / input devices

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

Published:
Part 216: Load referencing
Part 217: Thermal gear protection
Part 218: Dimming curve selection
Part 221: Load shedding
Part 222: Thermal lamp protection
Part 224: Integrated light source
In progress:
 Part 219: Power measurement
 Part 220: Centrally-supplied DC emergency operation
 Part 223: Light-output compensation over lifetime
 Part 225: Colour Tc
 Part 226: Colour xy

Published:
Part 301: Push buttons
Part 302: Absolute input devices
Part 303: Occupancy sensors
Part 304: Light sensors
Part 332: Input control devices - Feedback
Part 333: Manual configuration
In progress:
 Part 307: Relative input devices
Future part:
 Part 305: Colour sensor

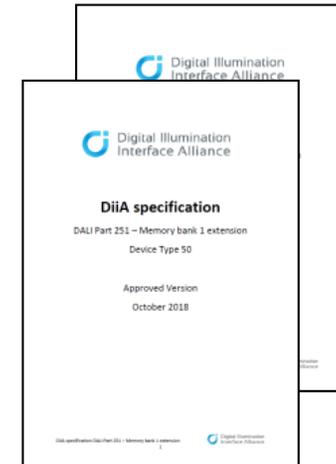
For Parts 207, 202 and others, DiIA adapts DALI version-1 test sequences for use with DALI-2.

Updated: June 2018

For latest information, see:
www.digitalilluminationinterface.org/dali/standards.html

New DiiA Specifications

- **DiiA has developed several new specifications**
 - For use in smart luminaires, and products attached to smart luminaires
- **Specifications:**
 - DiiA part 250 – Integrated Bus Power supply
 - DiiA part 251 – Memory Bank 1 Extension (Luminaire Data)
 - DiiA part 252 – Energy Reporting
 - DiiA part 253 – Diagnostics and Maintenance
 - DiiA AUX – Auxiliary Power Supply
 - Additionally, one further part is currently under development
- **Collaborations:**
 - DiiA plans to provide these specifications to the IEC 62386 working group (WG11).
 - DiiA also has collaborations with Zhaga and ANSI C137, related to these specifications.



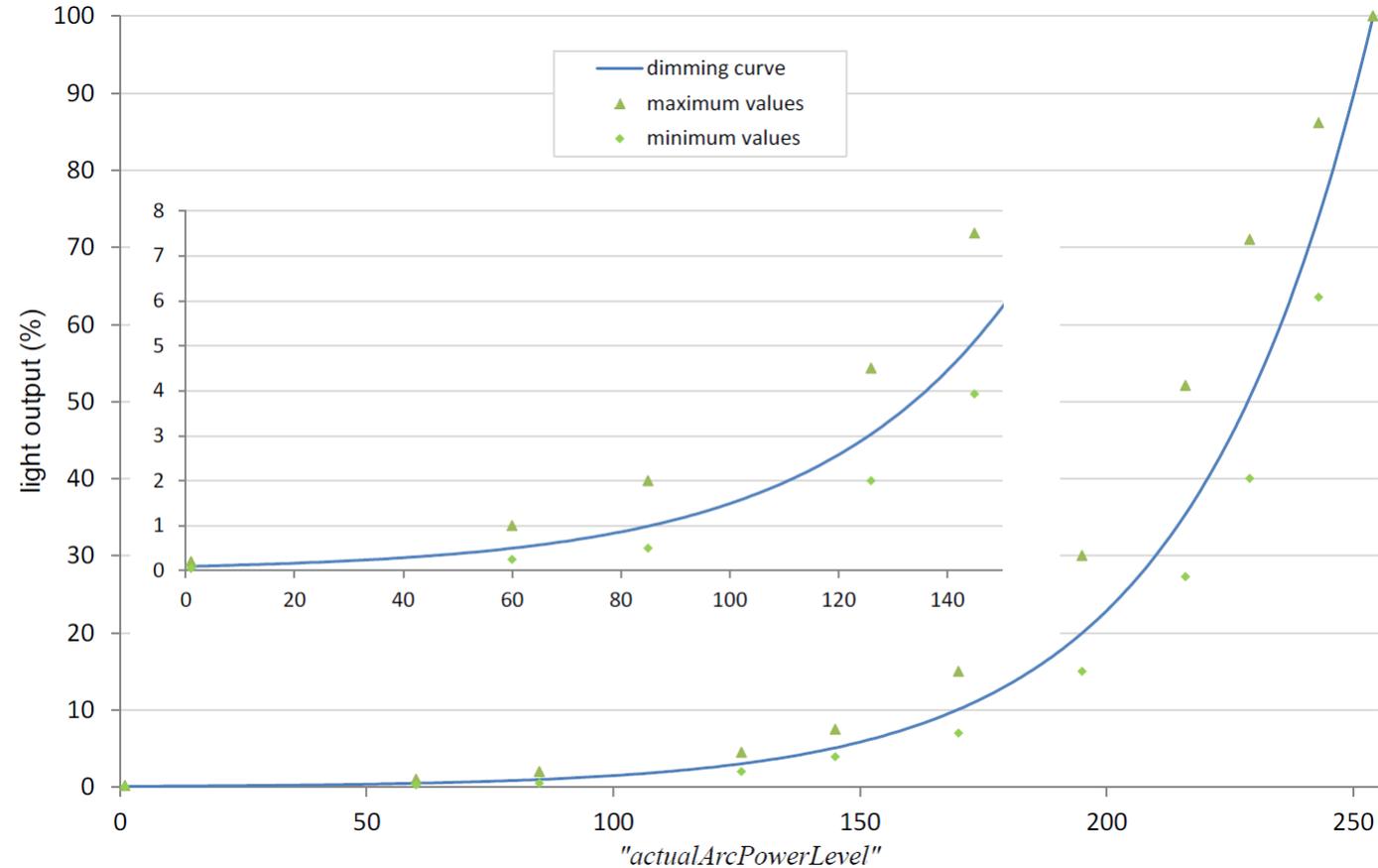
New DiiA Specifications - Applications

- A primary application for these new specifications is outdoor lighting, such as streetlights:
 - Streetlights are often closed DALI systems
 - A sensor or wireless communications module is often connected to the DALI bus
 - DiiA-Zhaga collaboration is standardising:
 - the connector/receptacles (Zhaga book 18)
 - the use of DALI for communications, and
 - the bus and auxiliary power supplies.
- **Some reasons that DALI was chosen:**
 - Industry standard
 - Specifically for lighting control
 - Direct connection to control gear
 - Standardised dimming curve (see next page)



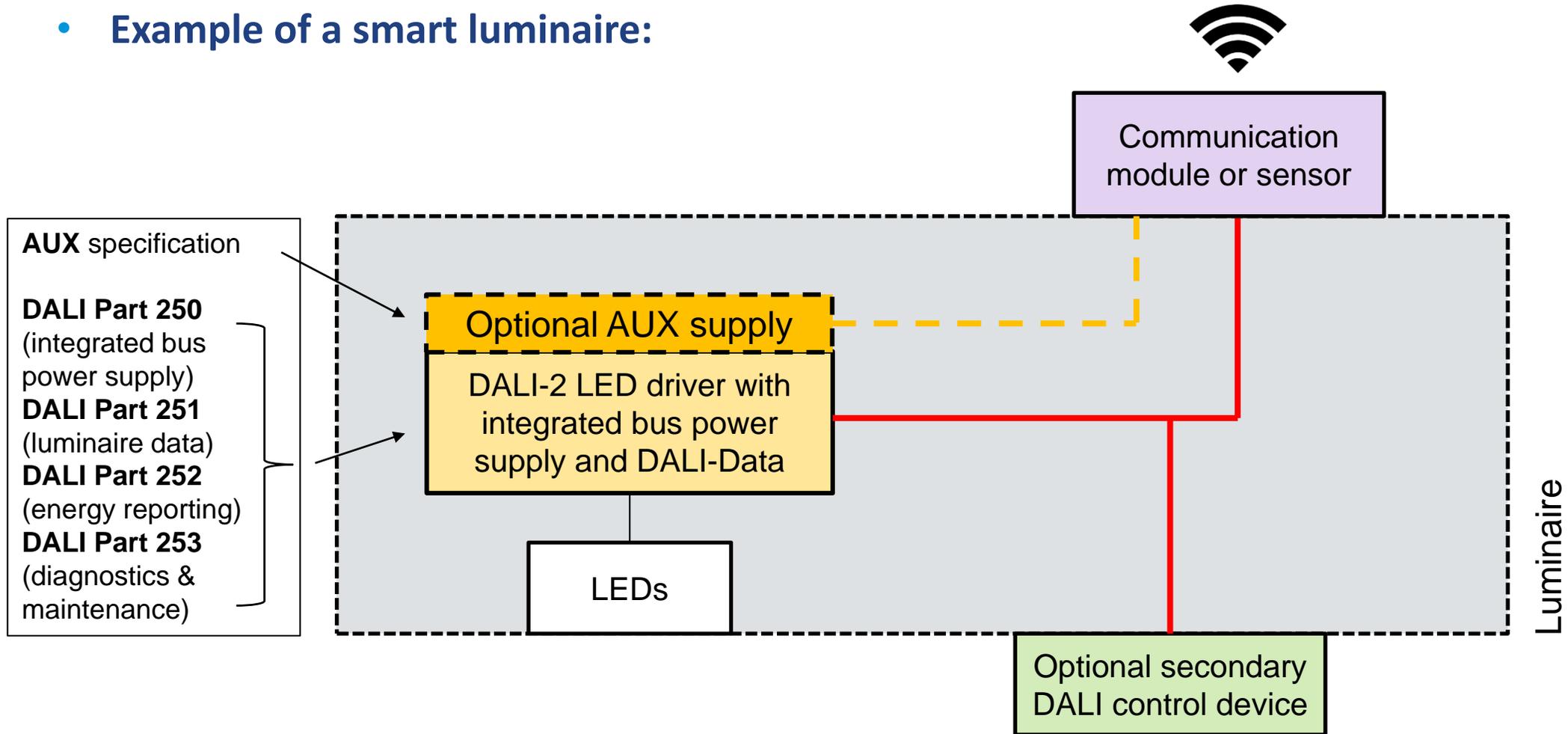
DALI – Standard dimming curve

- DALI standardises the dimming curve
 - Logarithmic – based on the human eye response
 - Each step is only 2.8% greater than the step below. For example, starting at 5%, the next step is 5.14%.
 - Minimum and maximum levels are configurable
 - The light output curve is tested
 - “Ask for 50%, get 50%”
 - tested to be within an allowed tolerance
 - Other protocols such as 1-10V do not specify the light output.



New DiiA Specifications – Smart luminaires

- Example of a smart luminaire:



New DiiA Specifications – next steps

- **Development of test sequences**
 - Allowing DiiA members to self-test or use an accredited test-house
 - The existing test system will be used where possible (25x parts)
- **Extension of the DALI-2 certification process**
 - New tests will make it possible for control gear with the new 25x and AUX PSU parts to be included in the DiiA certification program for DALI-2.
- **Certification for luminaires and sensor/communication modules**
 - Requirements being developed
 - Collaboration with Zhaga on certification and marking.

Application example – Emergency lighting system

- IEC 62386-202 allows full automation of emergency lighting control and testing
- Maintained and non-maintained types
- Fixed, switchable and dimmable types
- Systems can contain standard and emergency control gear, as well as control devices
- Emergency levels can be programmable
- **Testing:**
 - **Function test:** Lamp, battery, driver and charging circuit are tested, usually < 1 min
 - **Duration test:** Longer test for the full rated duration (usually 1-3 hours)
 - Can be manually triggered (bus command) or automatically triggered (periodic)
 - Test results can be queried and logged



Application example – Emergency lighting system

- **Emergency specific features include:**
 - **Inhibit mode:** Prevents emergency lamp operation when the mains fails.
 - **Rest mode:** Allows the lamp to be turned off when the mains supply is off.
 - **Extended emergency operation (prolong):** After the mains supply resumes, the lamp continues to operate from the battery for the prolong time.
 - **Battery charge state.**
- **DALI-2 update in progress**
 - DiiA is currently working on an update to include self-contained emergency control gear (part 202) in the DALI-2 tests and certification process.



Further information

- See the DiIA website:
 - Download the *DALI Quick Start Guide*:
www.digitalilluminationinterface.org/downloads/
 - **Product database**:
www.digitalilluminationinterface.org/products
 - **Membership benefits**:
www.digitalilluminationinterface.org/membership/benefits.html
 - **Contact us**:
info@digitalilluminationinterface.org

The screenshot shows the homepage of the Digital Illumination Interface Alliance. The header includes the logo and navigation links: Member Area, Logout, Contact, About Us, DALI, DALI-2, Products, Members, and News & Events. The main content area features a large blue and white logo with the text 'Digital Illumination Interface Alliance'. Below this, a headline reads 'The global industry alliance for DALI lighting control'. The text describes the alliance as an open, global consortium of lighting companies. It also mentions the DALI-2 certification program and provides links to find out more about DiIA, sign up for a mailing list, and follow on LinkedIn. Three main sections are highlighted: LATEST NEWS, MEMBERSHIP, and CERTIFICATION, each with a brief description and a link to more details.

