

DALI Summit, Session 1: DALI-2 certification and specifications

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25th September 2019, **DALI Summit, Bregenz, Austria**



Agenda

- **DALI-2: The global standard for smart, digital lighting control (S.Wade)**
- **Expanding DALI-2 certification for complete system coverage (R.Tol)**
- **New DiiA specifications and collaborations (S.Wade)**

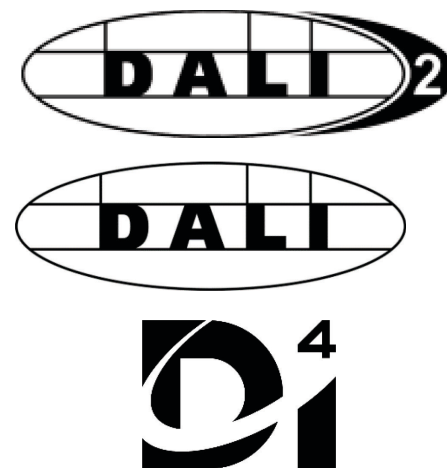
DALI-2: The global standard for smart, digital lighting control



Digital Addressable Lighting Interface

- **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 over a 2-wire bus
- **Individual, group & broadcast addressing** to any DALI device
- DALI, DALI-2 and D4i trademarks owned by  Digital Illumination Interface Alliance

- **190+ members** world-wide
- Membership allows DALI trademark use:
 - **600+ DALI-2** certified products
 - **1000+ DALI version-1** registered products
- **Membership types:**
 - **Regular**
 - **Associate**
 - **Community registration** – for luminaire makers



Membership benefits

	ASSOCIATE MEMBER	REGULAR MEMBER	COMMUNITY (note 2)
Access to DiiA test sequences	X	X	
Certification of DALI-2 products, use of DALI-2 logo on certified products	X	X	
Use of logos (DALI-2, DALI version-1) on luminaires containing DALI devices from DiiA members	X	X	X
Use of DALI version-1 logo on products other than luminaires	X	X	
Use of DiiA logo and DALI version-1 logo for marketing materials	X	X	X
Access to members-only website	X	X	
Participation in General Assembly meetings	X	X	
Receive membership communication	X	X	X
Access to draft deliverables (test sequences, specifications)		X	
Approval of final deliverables		X	
Participation and voting in working groups. Contribute to DiiA roadmap and development of test specifications.		X	
Participation in interoperability events (Plugfests)		X	
Eligible for Board of Directors membership		X	

Membership benefits:

www.dali2.org/membership/benefits.html

Member companies

Regular Members (24)



Associate Members (141)



First DiiA Members' Plugfest Vienna 4-5 September



- Number of **companies**: 19 registered, 18 attended (10 regular member companies)
- Number of **people**: 37 registered, 36 attended (not including DiiA Scott & Neil)
- **Feedback**:
 - All attendees were very positive about the Plugfest, particularly the first-timers – who were impressed by the cooperation between members to develop DALI. All appreciated the structured testing and learning opportunities afforded and gained confidence in their products. Most found minor issues, and areas for improvement.

DALI – Key facts & benefits (1)

- Technical limits
 - Maximum 64+64 addresses per DALI subnet
 - 64 drivers (control gear)
 - 64 control devices
 - Maximum 300 m cabling (between furthest-apart devices)
 - 250 mA max. bus power supply



DALI – Key facts & benefits (2)

- **Digital benefits**

- Robust communication
- Addressing: individual (64+64), groups (16/32) and broadcast (all)
- Flexible: Changes can be made via software
- Flexible: Simple operation “out-of-box”
- Two-way communication (feedback)



- **Cabling benefits**

- Standard 2-core cable (1.5mm²)
- Polarity-free & free wiring topology
- DALI power and data on same pair of wires



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

- **Wiring**
 - 0-10V: uses a **2-wire connection**, with thicker cables required for longer runs, to avoid voltage drop affecting the light output. Daisy-chain, star, tree and combinations allowed.
 - DALI: also use a **2-wire bus**, but polarity insensitive. Daisy-chain, star, tree and combinations allowed.
- **Bus power**
 - 0-10V: Drivers provide between 10µA and 2mA.
 - DALI: Up to 250mA allowed on DALI bus. Drivers consume 2mA max. Devices can be bus-powered.
- **Signal**
 - 0-10V: The voltage represents the light output, although the dimming curve is not standardised. (ANSI C137.1)
- **Other**
 - 0-10V: some manufacturers of control gear provide a non-standardised way to indicate a lamp has failed: the current sourcing in the control gear is turned off. Can be useful with a single driver.
 - DALI: **Configuration** can be changed in the control gear, for example fade time, groups and scenes. Information can also be **queried**, for example output level, lamp failure, emergency test status.
 - DALI: **Individual** devices **or groups** can be addressed/configured/controlled/queried.
 - DALI: Multiple points of control are allowed.

Common misconceptions

- DALI is a **European standard**.
 - **No!** IEC 62386 is a world-wide standard. DiiA member companies operate throughout most regions.
- DALI **devices are more expensive**.
 - Sometimes true, but the situation reversed in Europe as the DALI volume increased above the 1-10V volumes.
- 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**
 - There are now more than 600 DALI-2 certified products, and more than 1000 DALI version-1 registered products.
- The drivers and control devices need to be on **separate buses**
 - No – they are designed to allow connection to the same DALI bus. Look for the DALI-2 logo on the products.
- DALI is **expensive to install**
 - No – it is likely to be lower cost than 0-10V installations due to requiring less wiring
 - This makes the installation simpler and offers more robust communication.

Basic types of devices (1)

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

- Control gear
- Control devices
- Bus power supplies



Basic types of devices (2)

- **Control gear**
 - These are normally directly connected to the lamp, providing it with power
 - Example: LED driver



Basic types of devices (3)

- **Control devices** (two basic types)
 - **Application controllers** (make decisions and send commands to the control gear)
- **Input devices** (provide information to the system)
 - 301 Push-buttons
 - 302 Absolute inputs (switches, sliders)
 - 303 Occupancy sensors
 - 304 Light sensors
 - Tests and certification for these started on 20th May.



Basic types of devices (4)

- **Bus power supplies**



- Provide typically 16 V, up to 250 mA to power the bus.
- Often built into an application controller or control gear
- Devices such as sensors and push-buttons can be powered from the bus

DALI Quick Start Guide:
www.dali2.org/downloads

Expanding DALI-2 certification for complete system coverage

Ronald Tol, DiiA Technical & Certification Work Group Chair – Signify



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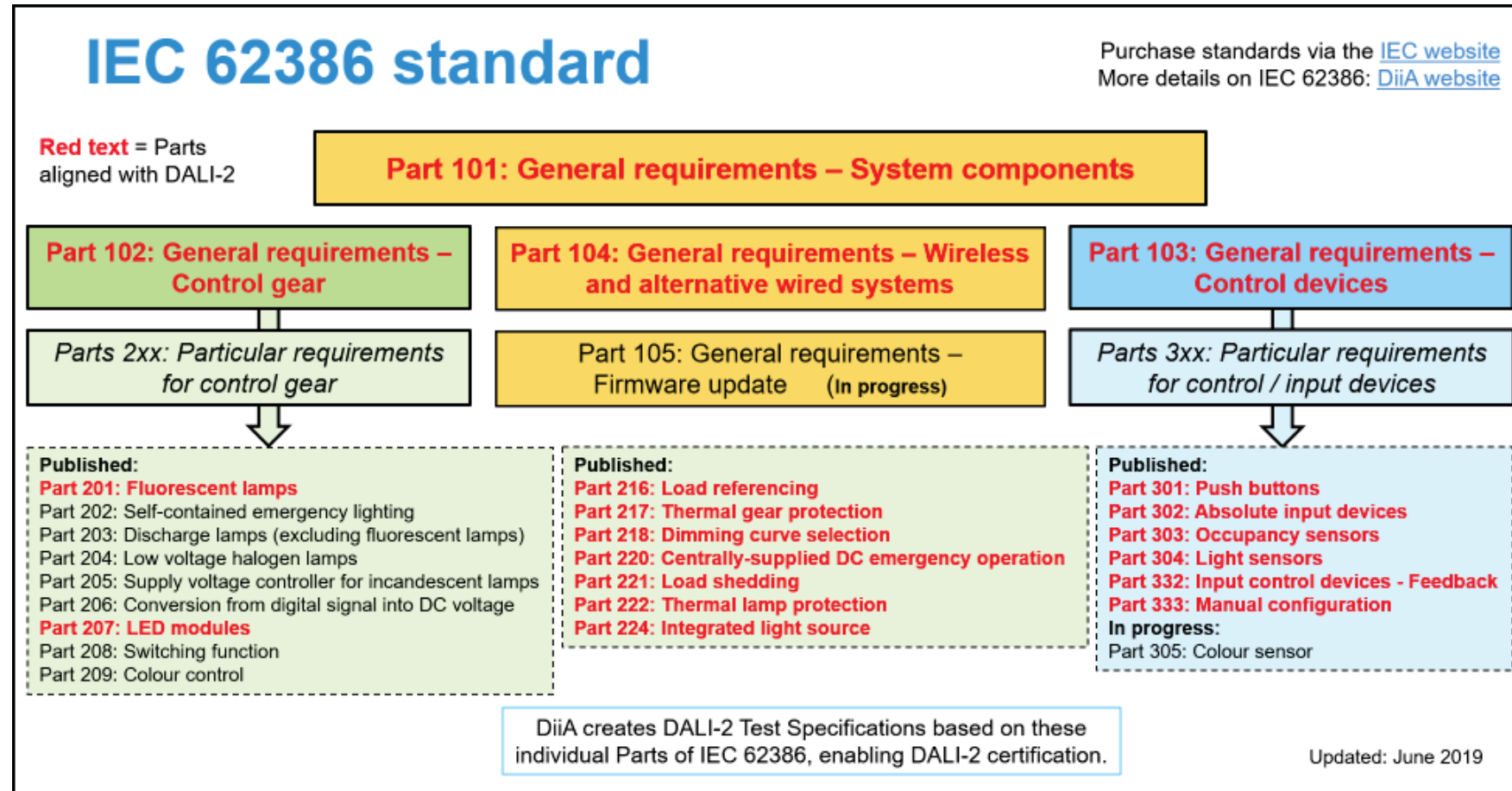
Expanding DALI-2 certification for complete system coverage

- The original “DALI” standard was for fluorescent control gear only.
- Later, additional lamp types and functionality were added for the control gear.
- Version 2 of IEC 62386 was released a few years ago, adding control devices for the first time.
- Since then, new parts have been added for input devices, and features for all control devices.
- The following page shows the various parts that make up IEC 62386

Product requirements are given in IEC 62386

Many parts defined:

- Example, LED driver
 - Parts 101, 102
 - Part 207
- Example, LED driver with colour control:
 - Parts 101, 102
 - Parts 207 (optional), 209



For latest information, see:

www.dali2.org/dali/standards.html

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

- **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!**

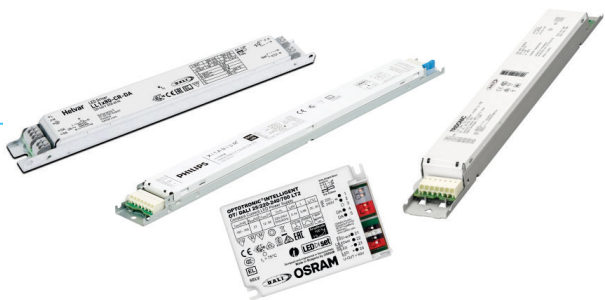
See a comparison and download the technical note on the DiiA website:

www.dali2.org/dali/comparison.html

Control gear

Part 102 gives the general requirements for all control gear

- Specifications include:
 - Directly changing the light level to a %
 - Scenes
 - Fading (fade time or fade rate)
 - Querying output level, lamp failure and other information
 - Memory banks
 - Addressing: short addresses, groups and broadcasting
 - Power on/start-up
 - Lamp/control gear failures



101 – General requirements – System (V1 & V2)
104 – Wireless System (in progress)
105 – Firmware update (in progress)
102 – Control gear (V1 & V2)
103 – Control devices (V2)

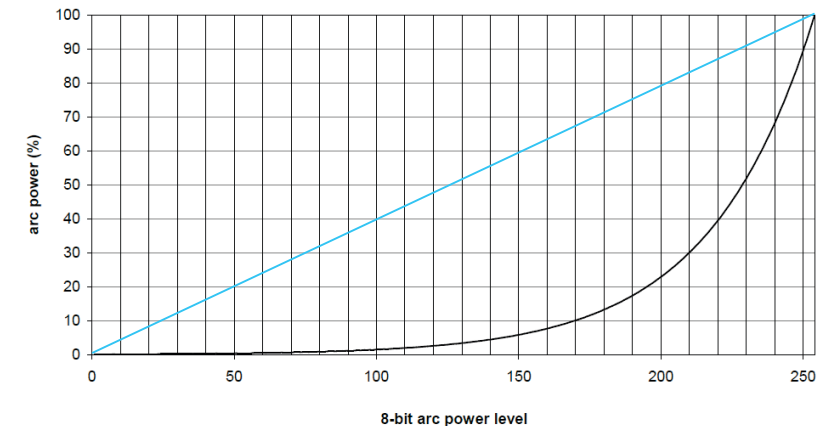
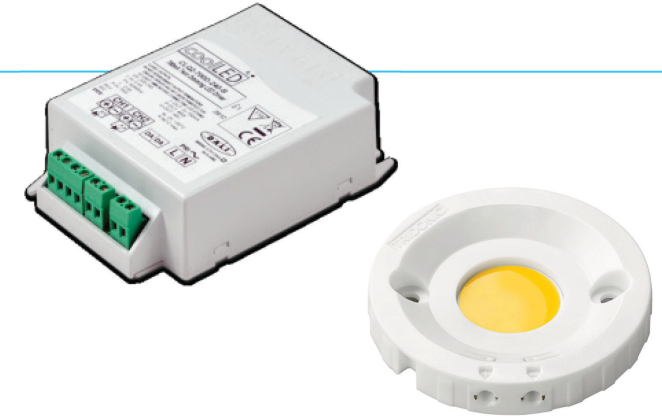
Specific parts

207 LED (V2 in progress)	208 Switching	209 Colour Control
204 LV Halogen	205 Incandescent Dimmer	206 Conversion to DC (0/1-10 V)
201 Fluorescent (V1 & V2)	202 Self-contained Emergency (V2 in progress)	203 HID

in progress (control gear functions):		
222 Thermal lamp information	220 Central emergency	224 Integrated Light source
		221 Load shedding
216 Load referencing	217 Thermal gear information	218 Dimming curve selection

Control gear – LED drivers

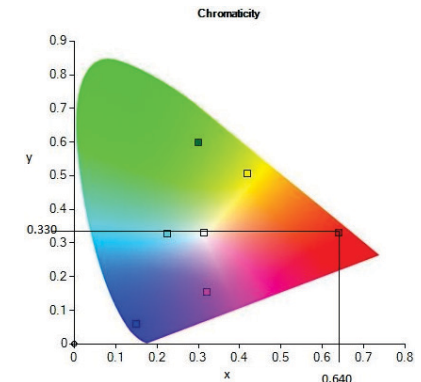
- **LED drivers** are the most popular type of control gear
 - **Part 207** gives the specific requirements, including:
 - Detection and reporting of various lamp fault conditions.
 - Detection and reporting of various control gear fault conditions.
 - Dimming curve selection:
 - Fast fade times.
 - Integration of a power supply and/or lamp.
 - Possibility of AC/DC supply.
 - Output control method: PWM, AM, current controlled, high current pulse (no further definitions)



Control gear – Colour control



- **Colour control** can be provided from control gear that has two or more lamps
 - **Part 209** gives the specific requirements, including:
 - Support for up to 6 channels or “primaries”
 - Several colour types are defined:
 - T_c – colour temperature control (“tuneable white”)
 - **RGBWAF** – a simple method of selecting a colour
 - **xy chromaticity** – allowing precise selection of colour
 - In addition, part 209 allows **calibration** of the attached “primaries”.
 - Fading from one colour to another is supported.
 - Tests for the T_c colour type are under development now.



Control gear – Emergency lighting

- **Self-contained emergency control gear** is used with a battery and lamp in a luminaire, providing light when the mains supply fails
- **Part 202** gives the specific requirements, including:
 - Support for **maintained** and **non-maintained** emergency lighting
 - Support for switched and dimmed control
 - Automated testing:
 - **Function tests:** check the lamp, driver/inverter, battery and charging circuit
 - **Duration tests:** check the operation of the lamp from the battery, for the full rated duration
 - Tests can be triggered automatically, or on reception of a command
 - Query commands for:
 - Features
 - Test results
 - Battery charge level
 - Failures



Control devices – Application controllers

- Can be very simple devices, or could be complex gateways interfacing with other systems
- **Single-masters: Only one can be used on the DALI bus**
 - Often these only support control gear, but may also be able to poll input devices.
- **Multi-masters: Follow the rules for shared use of the DALI bus**
 - Often they support both the polled and event driven methods of obtaining information from input devices.
 - The DiiA product database describes the supported features: www.dali2.org/products



Control devices – Input devices overview

- **Currently four types:**
 - 301 Push-buttons
 - 302 Absolute input devices (switches, sliders)
 - 303 Occupancy sensors
 - 304 Light sensors
- Up to 32 of these “instances” can be in the same product (using one address)
 - An example is a sensor consisting of an occupancy sensor (303) and a light sensor (304):
- Operation can be event driven, or polled, or periodic transmission.
- Optional “feedback” feature can be used to control LED indicators on each instance, for example on push-buttons.



Control devices – Input devices (301, 302)

- **Input device 301: Push-buttons**

- Various events can be sent:
 - Press, release, short-press, long-press, double-press, button-stuck



- **Input device 302: Absolute input devices**

- Simple on/off switches, or multi-position switches
- Digital inputs
- Analog inputs
- Slider or rotary controls
- Sends a “position” event



Control devices – Input devices (303, 304)

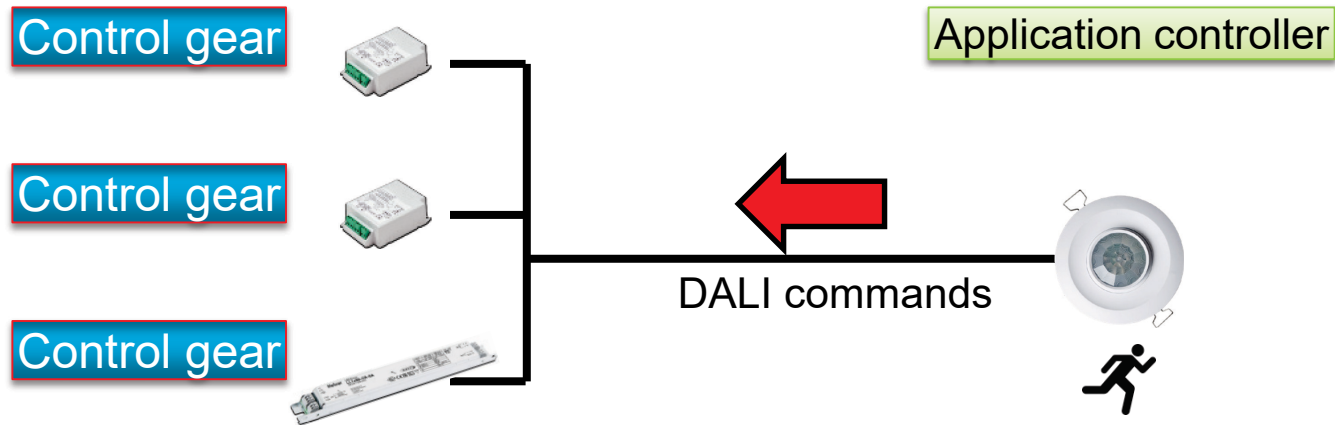


- **Input device 303: Occupancy sensors**
 - Movement or presence type sensors catered for.
 - Events can be triggered on state change to: occupied, vacant, movement, no movement.
- **Input device 304: Light sensors**
 - Measures illuminance level
 - Programmable hysteresis to minimise bus traffic
 - Optional periodic events reporting the illuminance level

Example – Out-of-box system operation

- **Products are wired together**, and work in a similar way to 0-10V systems, without needing any programming.
- Often called a “**broadcast**” **system** because commands are simply broadcast to all devices.
- Addresses, scenes, groups and other **configuration is not required**.
- Bus wiring can be used to divide the operation into groups of lights, in the same way as with 0-10V systems.
- The following example demonstrates this:

Example – Out-of-box system operation



- Control gear
- Application controller

Note:

- A bus power supply is required, either separate or integrated with an existing device.
- More than one application controller is allowed.

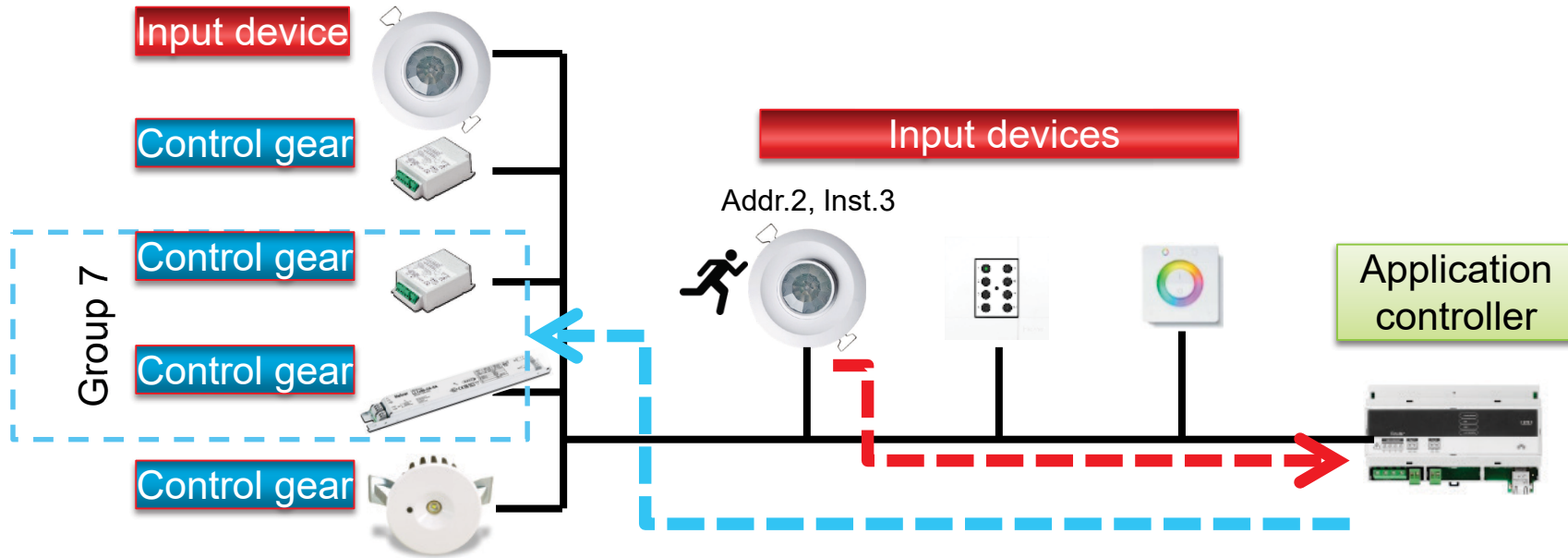
Example of operation:

- Movement triggers the sensor
- Sensor may automatically broadcast several commands:
 - **DTR0 (2)** [Data transfer register = 2]
 - **SET FADE TIME (DTR0)** [Set fade time to 1s]
 - **DAPC (254)** [Go to 100%]
- All lights react together by going to 100%.

Example - Commissioned (programmed) system

- **Products are wired together on the same DALI bus** (no need to divide the bus wiring).
- A **tool** is used to set-up the system.
 - Laptops, tablets, phones, IR handsets, LCD touch-panels or even wall-mounted push-buttons are examples of programming tools.
- Main programming steps are:
 - Assign **addresses**
 - **Group** the devices
 - Set-up scenes, fade-times and other parameters as required.
- The following example demonstrates this:

Example - Commissioned (programmed) system



- Control gear
- Input devices
- Application controller

Note:

- A bus power supply is required, either separate or integrated with an existing device.
- More than one application controller is allowed.

Example of operation:

- Movement triggers the sensor
- The occupancy sensor automatically transmits a notification:
 <address 2><instance 3> **INPUT NOTIFICATION (0x009)** [Movement detected]
- The application controller receives this, and decides to recall scene 5 in the group 7 lights:
 <group 7> **GO TO SCENE 5** [Change level according to scene 5]
- Lights in group 7 fade to the pre-programmed levels in scene 5.

Testing

- Products can be tested by the member company, or sent to an accredited test-house:
 - For **self-testing**, the following are required:
 - ProbitLab2 test platform
 - Official test-sequence software (downloaded from DiiA account)
 - Oscilloscope, voltage/current/resistance meter
 - Light meter (for testing of control gear and some control devices)



Accredited test-houses are listed on the website:

www.dali2.org/testing/test-houses.html

Trademark use

- Trademark use differs for DALI version-1 and DALI-2
- DALI trademarks  or **DALI**
 - **Successful test results must be obtained**, either by self-testing using the official test-platform and test-sequences, or by using an accredited test-house
 - **Registration** became mandatory for all DALI version-1 products from 1st June 2018.
 - New registrations of LED drivers ends on 31st December 2019.
 - **Test results** must be sent to the Certification Manager, if requested.
 - **DiiA members** may then use the DALI logo or “**DALI**” word trademark on their compliant products and product literature.
 - Registered products are automatically added to the **product database**:
www.dali2.org/products

Trademark use

- DALI-2 trademark 
 - **Successful test results must be obtained**, either by self-testing using the official test-platform and test-sequences, or by using an accredited test-house
 - **Product information and test result registration/certification file are then submitted to the certification tool through your DiiA account.**
 - **Product information and results are verified.**
 - **Further test results** must be sent to the Certification Manager, if requested.
 - Once certification is granted, one certification credit is consumed from the member company's account.
 - **DiiA members** may then use the DALI-2 logo or “**DALI-2**” word trademark on their compliant products and product literature.
 - Certified products are automatically added to the **product database**:
www.dali2.org/products

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**

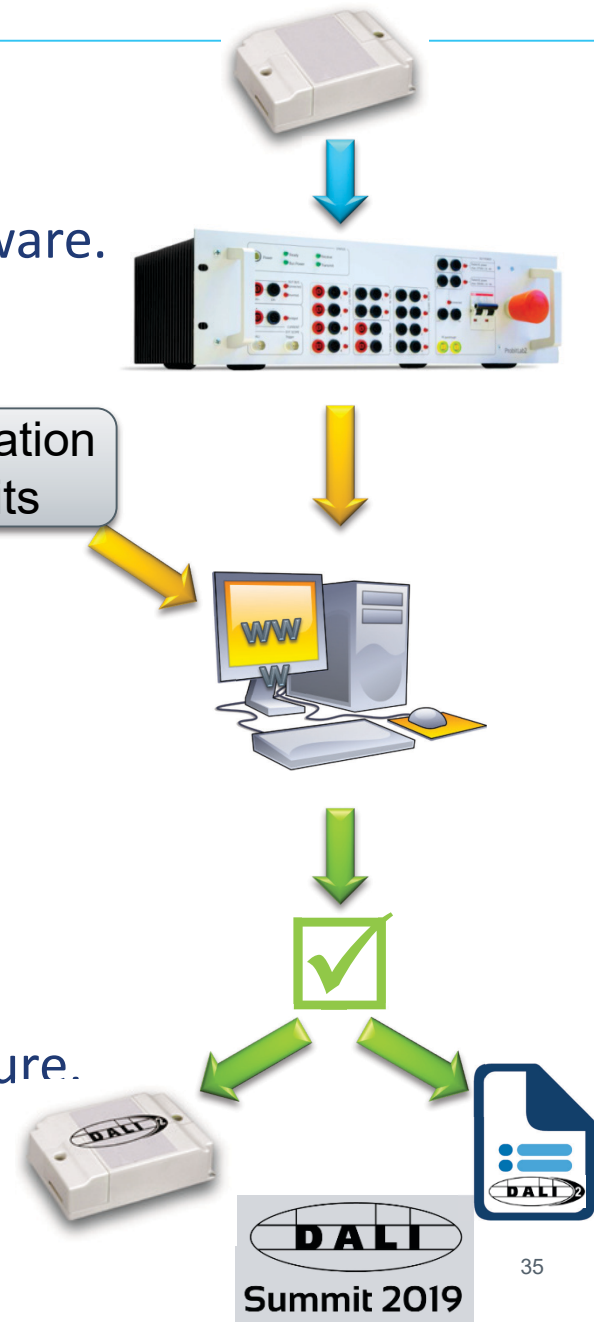


- Test results and product information is checked.

- **Trademark use:**



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



Product database (public)

- Lists all DALI-2 certified products, as well as DALI version-1 registered products
- Used for two main purposes:
 - **Check** if a product that shows the DALI-2 (or DALI) Trademark is really certified (or registered)
 - **Find** and select suitable products for an installation.
- If a product isn't listed, it isn't certified.
 - This means Trademark use is not permitted.



Product database:

<http://www.dali2.org/products>

The screenshot shows the 'Product database' page of the Digital Illumination Interface Alliance. It includes a search bar with a dropdown menu for 'Product Search' and a 'Show products 1-25' section. Below this is a table of products.

Brand Name	Product Name	DALI Parts	Registration Date	DALI 2 Certified
LEFud	LF-GSD200T	881.508.207	Apr 30, 2019	Yes
LEFud	LF-GSD200E	881.502.207	Apr 30, 2019	Yes
Switcher	Long Metal 25W LED Driver SPB-2000-A-25CVT	881.108.207	Apr 30, 2019	Yes
50.Amsterdam ACS	LEDOne DALI	881.503	Apr 29, 2019	Yes

New DiiA specifications and collaborations

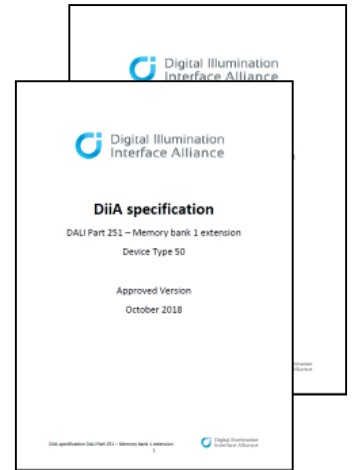
Scott Wade, DiiA Technical & Certification Manager – DiiA



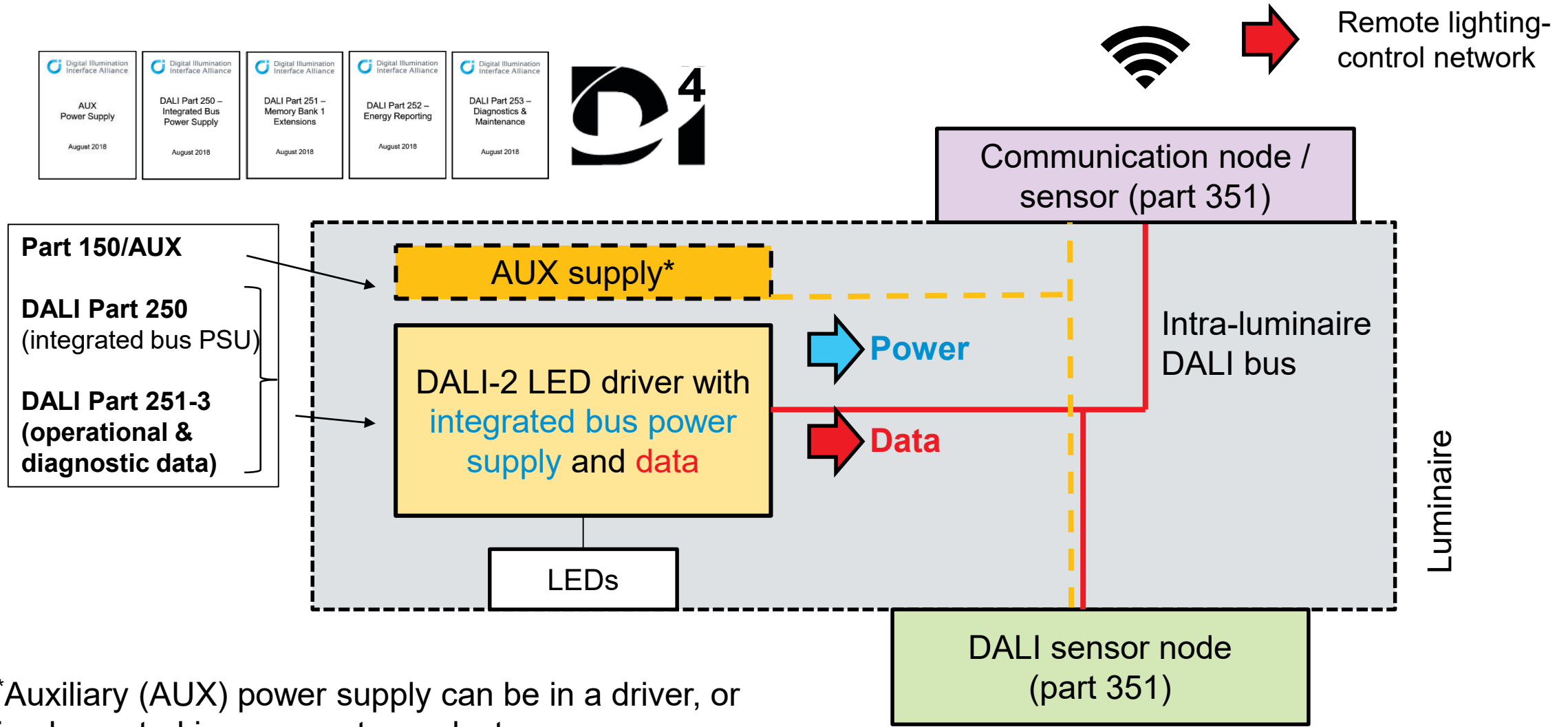
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New DiiA Specifications

- **DiiA has developed several new specifications**
 - For use in smart luminaires, and products attached to smart luminaires
- **Specifications (www.dali2.org/specifications/download.html):**
 - 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 part 150 – AUX Power Supply
 - DiiA part 351 – Luminaire mounted control devices (under development)
- **Collaborations with:**
 - IEC TC34/WG11, Zhaga and ANSI C137.

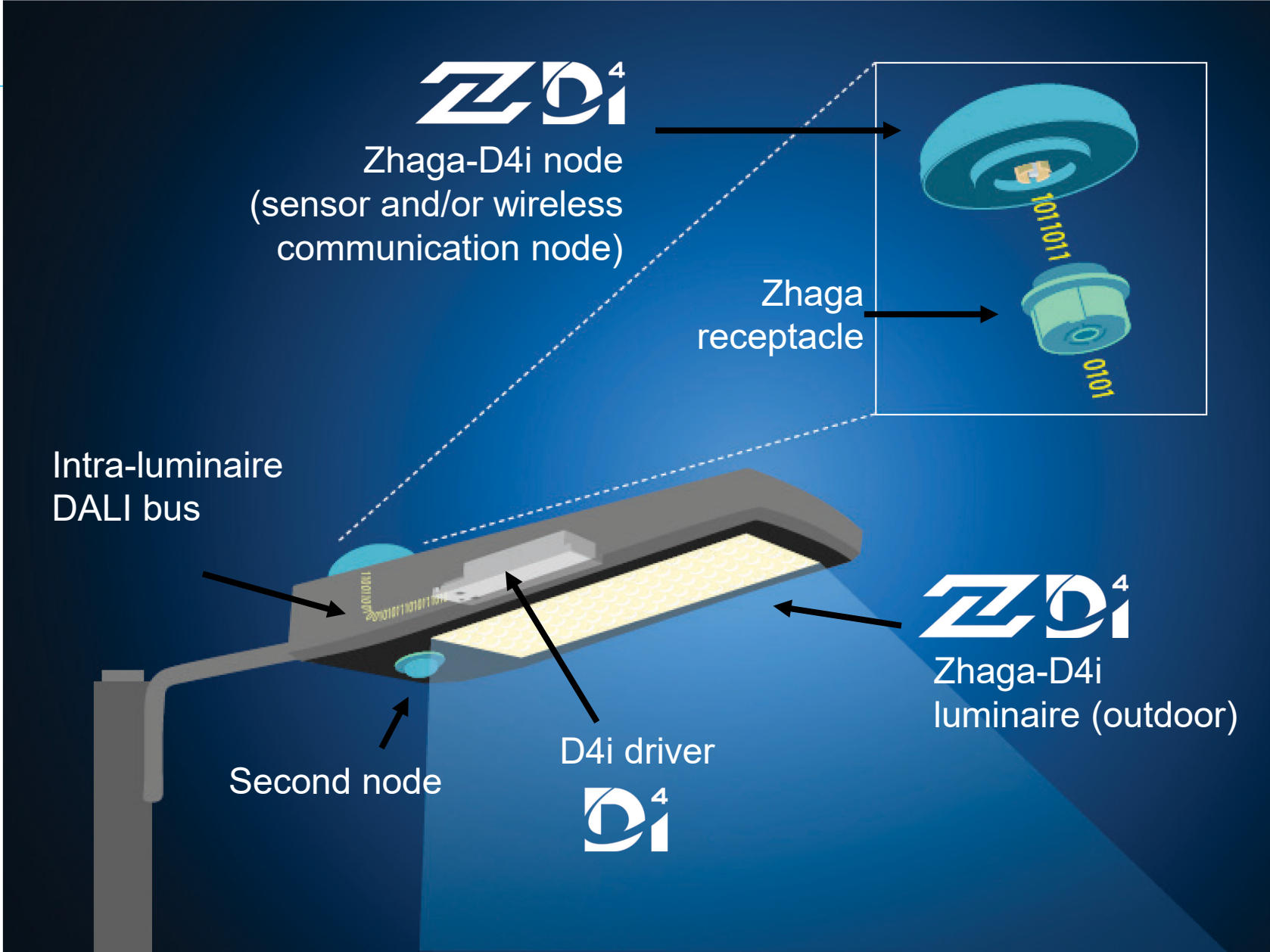


D4i specifications for intra-luminaire DALI (outdoor luminaires)



*Auxiliary (AUX) power supply can be in a driver, or implemented in a separate product.

Zhaga – D4i



Applications

- **A primary application for these new specifications is outdoor lighting, such as streetlights:**
 - Each streetlight is a small DALI system
 - 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
 - Bi-directional communication



New DiiA Specifications – Part 250

- **DiiA part 250 – Integrated Bus Power supply:**
 - For control gear
 - Includes:
 - **Integrated DALI bus power supply:**
 - Suitable for powering sensors or communication modules in a luminaire
 - **Memory bank:**
 - Current ratings can be read
 - PSU can be enabled or disabled – allowing use in systems with multiple bus PSUs
- For D4i certification, part 250 must be included, with the bus power supply enabled by default.

New DiiA Specifications – Part 251

- **DiiA part 251 – Memory bank 1 extension:**
 - For control gear
 - **Memory bank describes luminaire information, including:**
 - Supply power and voltage ratings
 - Light output, including CCT/CRI ratings
 - Light distribution type
 - Luminaire colour
 - Text luminaire identification/descriptions

New DiiA Specifications – Part 252

- **DiiA part 252 – Energy reporting:**
 - For control gear
 - Includes:
 - Active energy and power
 - Apparent energy and power (optional)
 - Load side energy and power (optional)

New DiiA Specifications – Part 253

- **DiiA part 253 – Diagnostics & Maintenance:**
 - For control gear
 - Includes:
 - **Failure conditions**
 - Various control gear failure conditions
 - Various lamp failure conditions
 - **Counters for each failure type**
 - **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

New DiiA Specifications – Part 150 AUX

- **DiiA specification AUX power supply:**
 - Can be integrated in control gear
 - 24V PSU, 3W average power, 6W pulse capability
 - Intended to supply external sensor or communication modules
 - For example, Zhaga book 18 socket used on outdoor luminaires/street lights
 - Designed to supply outdoor wireless communications transceivers that require high power pulses during transmission

New DiiA Specifications – Part 351 Luminaire mounted control devices

- **Not yet published by DiiA**
- **Describes two main requirements for luminaire mounted control devices:**
 - Power consumption requirements.
 - Can be AUX powered or bus-powered, within specified limits.
 - Polarity sensitivity exception permitted.
 - Two types of sensors: type A and type B
 - **Type A:** Application controller takes control. Up to 2W from AUX.
 - **Type B:** Contains arbitration logic so its application controller relinquishes control when another application controller is present. Up to 1W from AUX, or 46mA bus-powered.
 - These requirements allow a maximum of **one type A** and **one type B** device to be used without requiring further configuration.
 - **Type C** being added for indoor use-cases.

New DiiA Specifications – next steps

- **Development of test sequences**
 - Allowing DiiA members to self-test or use an accredited test-house
 - The existing ProbitLab2 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.
 - Requirements are being developed for luminaire mounted control devices (part 351).
- **D4i certification**
 - If certified **control gear**, certified **control devices** or **luminaires** meet the D4i requirements, then use of the new D4i Trademark logo is allowed in accordance with the *Trademark Guidelines for Members*.
 - Trademark requirements are being updated to include the requirements for D4i.



Specifications from IEC and DiiA – Parts in progress

The IEC 62386 Working Group (WG11) is working on several new parts, as well as updates to existing parts:

- **1xx**
 - **104** Wireless and alternative wired system: published in May 2019.
 - **105** Firmware transfer: publication expected in 2020.
- **2xx**
 - **202** – Self-contained emergency control gear: update in progress.
 - **220** – Centrally controlled emergency operation: published in January 2019.
- **3xx**
 - **305** – Colour sensor: draft started in 2019
- **Upcoming DiiA specifications:**
 - **351** – Luminaire mounted control devices
 - **306** – General purpose sensor

Test sequence & certification updates

- **Latest test release, 20th May 2019:**
 - 301-304 **input device** tests.
 - Fixes and improvement for parts 101-103, including better support for multiple logical units.
- **Currently in progress:**
 - 150/AUX power supply, 250-253 (D4i specifications for control gear). Beta testing in progress. Release expected end of October.
 - 209 (DT8 test for colour type T_c). Beta testing in progress. Release expected end of 2019.
 - 208 (relay switching), 351 (Luminaire mounted control devices). Test specifications being completed.
 - 202 (self-contained emergency). Test specification update in progress.
- **Next-on tests:**
 - 205 (incandescent dimmer), 206 (1-10V converter)

Further information – DiiA website:

- **DALI Quick Start Guide:**
<http://www.dali2.org/downloads/>
- **Product database:**
<http://www.dali2.org/products>
- **Membership benefits:**
<http://www.dali2.org/membership/benefits.html>
- **D4i:** <https://www.dali2.org/d4i/>
- **Contact us:**
info@digitalilluminationinterface.org



www.dali2.org