# DALI-2:

# The global standard for smart, digital, lighting control in the IoT era

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#### Agenda

- DALI & DiiA overview, key facts & benefits, comparison with 0-10V (Scott Wade, DiiA)
- Q&A
- New DiiA specifications smart luminaires (Ronald Tol, Signify/DiiA)
- Proposed American National Standard For Lighting Systems Digital Interface with Auxiliary Power (Michael S. O'Boyle, Signify/ANSI)
- An End User's Perspective to Using DALI for Outdoor Lighting (Kevin Fitzmaurice, Georgia Power)
- Q & A



#### **DALI & DiiA**



- 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 and DALI-2 trademarks owned by





#### **G** Digital Illumination Interface Alliance **Membership (May 2019)**

- 170+ members world-wide
- Membership allows DALI trademark use:
  - 435 DALI-2 certified products
  - **1048 DALI version-1** registered products
- Membership types:
  - Regular
  - Associate
  - **Community registration** for luminaire makers



#### Digital Illumination Interface Alliance Membership benefits

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



#### Membership benefits:

www.dali2.org/membership/benefits.html



#### **Member companies**

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#### max. 64+64 addresses per DALI subnet

**DALI – key facts & benefits** 

- max. 300 m cabling (between furthest-apart devices)
- max. 250 mA bus power supply

#### **Digital benefits**

**Technical limits** 

- Robust communication
- Addressing: individual (64+64), groups (16/32) and broadcast (all)
- Flexible: Simple operation "out-of-box", or changes can be made via software
- Two-way communication (feedback)
- **Cabling benefits** 
  - Standard 2-core cable (1.5 mm<sup>2</sup>)
  - 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 see following slides)
  - Application controllers
  - Input devices



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

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







#### **DALI – key facts – control devices**

- Control devices (IEC 62386-103) are new to the DALI-2 standard. 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.

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- Input devices
  - Fairly simple devices that provide information to the system.
  - Examples include push-buttons, sliders, occupancy sensors, and light sensors.







#### **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: <u>www.dali2.org/products</u>





#### **Control devices – input devices**

- 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**

#### Input device 301: Push-buttons

- Events can be sent on:
  - 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



#### **Control devices – input devices**



- 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



#### System example – Out-of-box system operation

- **Products are wired together**, and work in a similar way to 0-10V systems, without needing any programing.
- 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.
- There are still advantages over 0-10V:
  - multiple controls can be used; controls can co-operate; push-button feedback LEDs; controls can be powered from the bus; programing can be done later if required...
- The following example demonstrates this:



#### System example – Out-of-box system operation



•

Control gear

 Application controller (control device)

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%.



#### System example - Commissioned (programed) 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 programing tools.
- Main commissioning (programing) steps are:
  - Assign addresses
  - **Group** the devices
  - Set-up scenes, fade-times and other parameters as required.
- The following example demonstrates this:



#### System example - Commissioned (programed) system



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- [Change level according to scene 5]
  - All lights in group 7 fade to the pre-programed levels in scene 5. •

Control gear

devices)

Note:

Input devices (control

Application controller

Systems can contain more than

A bus power supply is required,

either separate or integrated with

(control device)

one application controller.

an existing device.

#### 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 programing, gives at least the level of operation obtained from 0-10V.
  - Programing, if required, varies between manufacturers.
- Products are not available
  - The choice is increasing. Additionally, some companies may already have implemented DALI in their products without stating they use DALI communications.
- The drivers and controls 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.

# 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

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- 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





# 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: <a href="http://www.dali2.org/testing/test-houses.html">www.dali2.org/testing/test-houses.html</a>
- Products that can be tested:
  - Control gear of various types, with LED drivers being the most popular.
  - Control devices: application controllers, and the recently added input devices.
  - Bus power supplies (and integrated bus power supplies)





# **DALI-2 Certification**

- -12
- 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 the product



- 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

#### **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.



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#### IEC 62386 Parts

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





#### For latest information, see:

www.dali2.org/dali/standards.html



### **Further information**

- See the DiiA website:
  - Download the DALI Quick Start Guide: <u>http://www.dali2.org/downloads/</u>
  - Product database:

http://www.dali2.org/products

• Membership benefits:

http://www.dali2.org/membership/benefits.html

• Contact us:

info@digitalilluminationinterface.org



C Digital Illumination Interface Alliance		Member Area Logout Contact
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	Digital Illumi	nation
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The global inc	dustry alliance for DALI (DEA) is an open, global consortium of lighting is colutions based on Digital Addressable Light	lighting control
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Building on the long-established bene significantly improved interoperability an	d additional functionality compared with curre market.	nt DALI systems in the DALI
>> Find out more i	about DiA> Sign up to our mailing list ->> Fo	ollow us on LinkedIn
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LATEST NEWS	MEMBERSHIP	CERTIFICATION
<ul> <li>DALI-2 version of Part 207</li> <li>DiiA publishes DALI Quick Start Guide</li> <li>First DALI-2 luminaires registered</li> <li>DiIA and Zhaga start cooperation &gt;&gt; More details</li> </ul>	DiA is an open, global consortium, and new members are welcome to join us. We now have more than 130 members? To find out why your company should become a DiA member click here	DALI-2 certification builds further confidence in the interoperability of DALI products. Members have already certified DALI-2 control gear, application controllers and bus power supplies.xxMore details

# Questions?

#### Agenda

- DALI & DiiA overview, key facts & benefits, comparison with 0-10V (Scott Wade, DiiA)
- Q&A
- New DiiA specifications smart luminaires (Ronald Tol, Signify/DiiA)
- Proposed American National Standard For Lighting Systems Digital Interface with Auxiliary Power (Michael S. O'Boyle, Signify/ANSI)
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- Q & A



# **New DiiA Specifications**

- DiiA has developed several new specifications
  - For use in smart luminaires, and products attached to smart luminaires
- Specifications (<u>www.dali2.org/specifications/download.html</u>):
  - 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
  - DiiA part 351 Luminaire mounted control devices (under development)
- Collaborations with:

Digital Illumination

- IEC TC34/WG11 on IEC62386, Zhaga and ANSI C137
- It is expected these 5 new specifications will be included in IEC 62386



#### **D4i specifications for intra-luminaire DALI**



# **New DiiA Specifications – Applications**

#### A primary application for these new specifications is outdoor lighting, such as streetlights

- Each streetlight can be a single 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.
- Through participation in ANSI C137.4:
  - Power supplies, asset management
  - Reference to 'NEMA' socket



#### Some reasons that DALI was chosen:

- Industry standard
- Specifically for lighting control
- Direct connection to control gear
- Standardised dimming curve
- Bi-directional communication



# Integrated bus power supply and AUX power supply

- DiiA Part 250 Integrated DALI bus power supply:
  - Provides at least 50mA on the DALI bus
  - Useful to power sensors or other control devices
  - Memory bank 201:
    - Allows the guaranteed and maximum currents to be read
    - Allows the bus power supply to be enabled/disabled
- AUX power supply
  - 24V DC auxiliary power supply
  - Can be used by sensors or communication modules attached to the luminaire
  - 3W average power
  - 6W peak power
    - Supports city-wide wireless communications requiring high peak transmission power







# **DiiA part 251 – Memory bank 1 extension**

- Memory bank 1 includes luminaire information such as:
  - GTIN
  - date of manufacture
  - nominal input power
  - power at minimum dimming level
  - supply voltage range
  - nominal light output
  - CRI
  - CCT
  - light distribution type
  - luminaire colour
  - luminaire description
- Useful for asset management applications







# **DiiA part 252 – Energy Reporting**

- Memory bank 202:
  - Active energy and power
- Memory bank 203 (optional):
  - Apparent energy and power
- Memory bank 204 (optional):
  - Load-side energy and power

G Digital Illumination Interface Alliance
DiiA specification
DALI Part 252
Energy reporting
(Device Type 51)
Version 1.0 February 2019
The application of the Table - Series reporting





# **DiiA part 253 – Diagnostics and Maintenance**

- Memory bank 205 Control gear diagnostic and maintenance information:
  - Operating time, start counter, external supply voltage, external supply frequency, power factor, overall failure condition, overall failure counter, external supply under-voltage & counter, external supply over-voltage & counter, output power limitation & counter, thermal derating & counter, thermal shutdown & counter, temperature, output current %.



#### • Memory bank 206 – Light source diagnostics and maintenance information:

- Start counters, on-time counters, voltage, current, overall failure condition & counter, short-circuit & counter, open-circuit & counter, thermal derating & counter, thermal shutdown & counter, temperature.
- Memory bank 207 Luminaire maintenance data:
  - Luminaire lifetime, control gear reference temperature, rated light-source starts.



Photo: Georgia Power / Buildings magazine



#### **DiiA part 351 – Luminaire mounted control devices**

- Draft specification nearing completion
- Allows two types of control devices: Type A and B
  - Maximum of one type-A and one type-B control device can be connected.
- Examples
  - Type A: an outdoor luminaire controller with city-wide wireless communications
  - Type B: a light or occupancy sensor



#### **New trademarks**

• New wordmark ('D4i') and new logo:



- Used on drivers, control devices and luminaires to indicate D4i certification
- D4i Certification of drivers:
  - Parts 207 and 250-253 implemented. Part 250 bus power supply default state: "enabled".
- D4i Certification of control devices:
  - Part 351 implemented
- D4i use on luminaires:
  - All drivers are certified for D4i.
  - Only include control devices meeting the DALI-2 and D4i requirements.
  - At most one type A and one type B control device as per Part 351.

#### **Streetlight with sockets for nodes**





#### **Benefits**

- Easy to add or upgrade sensors and/or communication nodes:
  - Enables future-proof luminaires that can keep pace with rapid developments in digital networking and sensing technology.
- Intra-luminaire DALI-2 bus:
  - Enables bi-directional interaction between sensors and/or communication nodes and LED drivers using the well-established and standardized DALI protocol.
- D4i drivers are smart:
  - Able to report operational and diagnostic data to an external network, and can provide inventory-related information about the luminaires.
- IoT connectivity:
  - With a suitable wireless communication node, the luminaire is able to interact with an external lighting-control network, and to participate in the IoT.



#### **Co-operation with Zhaga**

- Zhaga-D4i certification: A joint program from Zhaga and DiiA
  - Certification for interoperable luminaires and sensors and/or communication nodes
- Based on complementary specifications from Zhaga and DiiA
  - Zhaga **Book 18** plus **D4i** specifications from DiiA
- Product certification enables use of communication nodes.



on outdoor luminaires, sensors and

- Logo indicates multi-vendor product interoperability
- Initial focus on outdoor lighting
  - Indoor solutions will also be developed



#### Zhaga – D4i





#### Scope of Zhaga–D4i certification



<sup>1</sup>Zhaga-D4i Node = D4i certified sensor and/or communication node with a Zhaga Book 18 plug <sup>2</sup>Zhaga-D4i Luminaire = has a powered Zhaga Book 18 socket and contains a D4i driver



