Digital lighting control for intelligent, user-friendly, connected buildings

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Smart Buildings Show

October 6, 2021

DALI® Alliance

DALI®2 D4i™ DALI+

Agenda

Digital lighting control for intelligent, user-friendly, connected buildings

- Introduction: DALI & the DALI Alliance
- Benefits of DALI for lighting
- DALI in smart buildings
  - DALI data
  - DALI for wellbeing and comfort
- D4i and IoT luminaires
- Connectivity – Gateways and DALI+

- DALI Lighting Awards

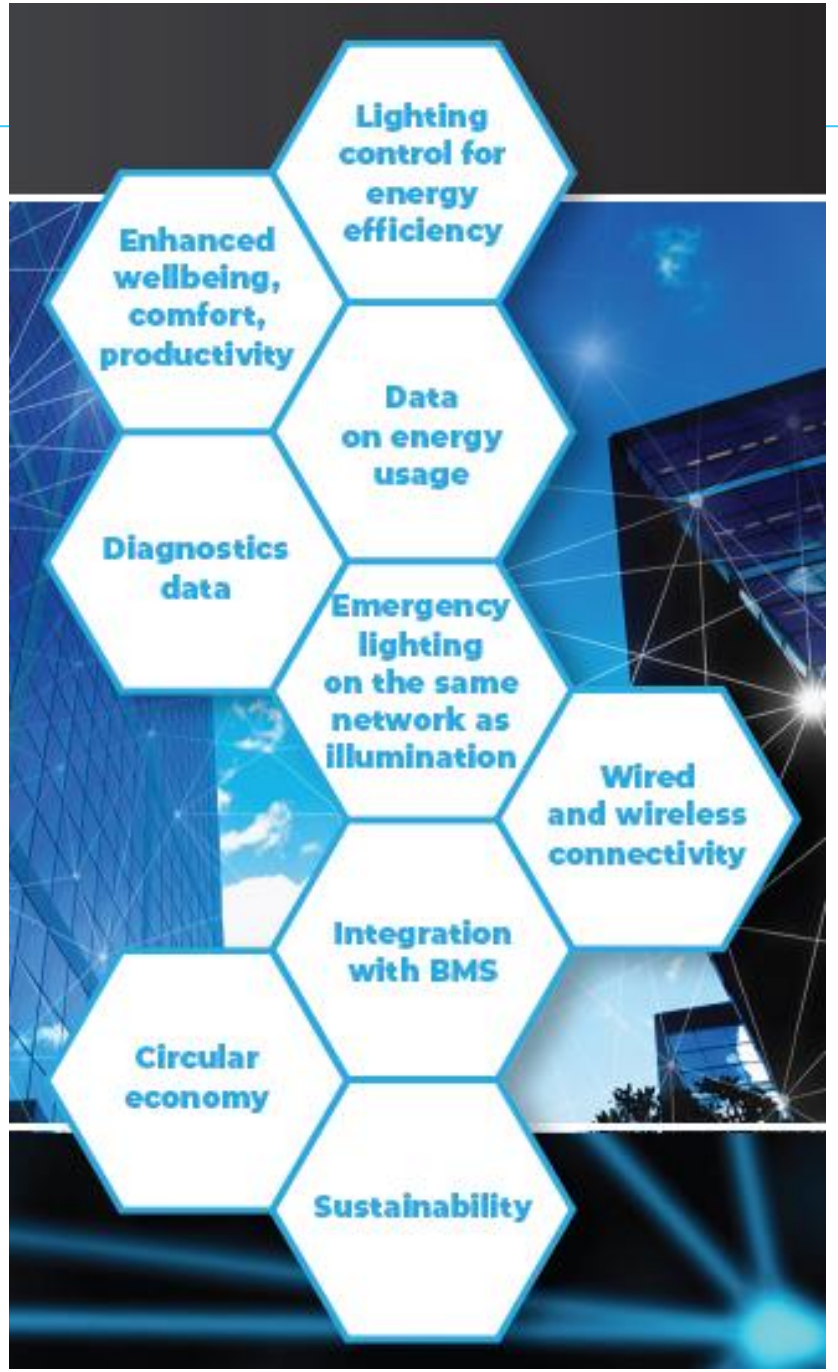
DALI® Alliance

Our new identity explains that we are the **global industry organization for DALI**
We are also known as the
Digital Illumination Interface Alliance(DiiA)

Digital Illumination Interface Alliance

Smart lighting control

- Lighting control for energy efficiency
- Enhanced wellbeing, comfort, productivity
- Data on energy usage
- Diagnostics data
- Emergency lighting on the same network as illumination
- Intelligent, IoT-ready luminaires and sensors
- Wired and wireless connectivity
- Integration with BMS
- Circular economy



Introduction:
DALI & the DALI Alliance

DALI: The basics

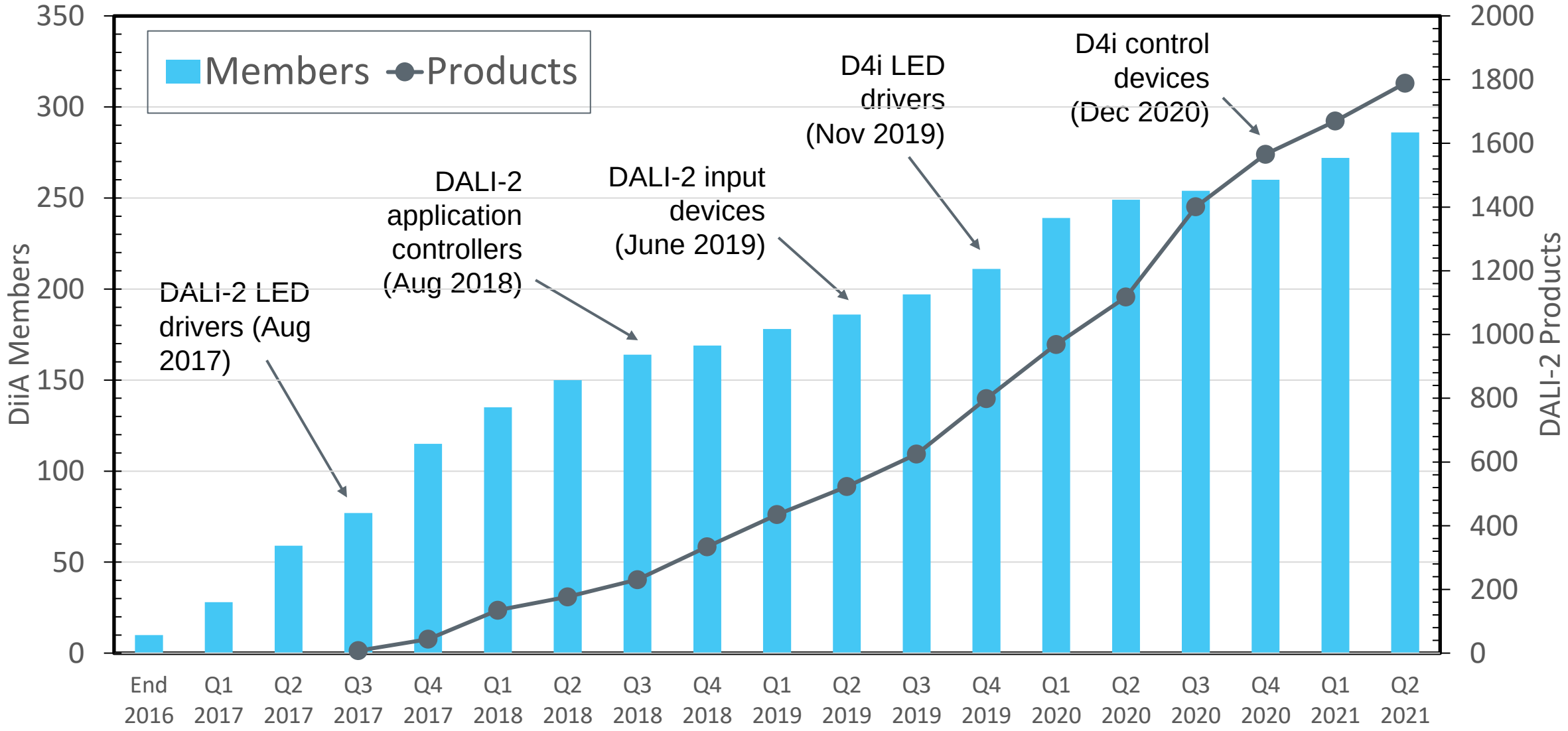
Digital **A**ddressable **L**ighting **I**nterface

- DALI® is the industry-standard protocol (language) for bi-directional, digital communication between lighting-control devices.
  - Dedicated to lighting, with a rich feature set
- DALI is derived from the open, global standard IEC 62386.
- DALI-2™ is the certification program based on the latest version of the DALI protocol.
- DALI-2 is driven by the DALI Alliance (DiiA)
  - Ensures interoperability through testing and certification with trademark use
- DALI, DALI-2, D4i and DALI+ trademarks controlled by the DALI Alliance (DiiA)

The DALI Alliance

- The DALI Alliance is an open, global consortium of lighting companies that aims to grow the market for lighting-control solutions based on DALI.
- Also known as Digital Illumination Interface Alliance
- Almost **300 members** worldwide
  - Industry leaders in lighting and control
  - Full list on our website
- Membership allows certification or registration of products:
  - Over **1,900 DALI-2 certified products**
  - Over 1,450 DALI version-1 registered products
- Membership allows DALI, DALI-2, D4i and DALI+ **trademark use**.

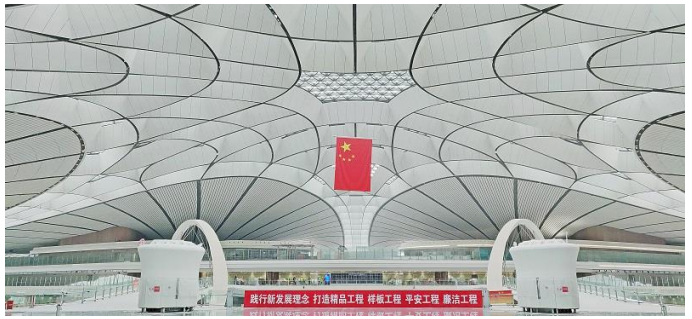
Members and DALI-2 certified products



DALI market

- Very large installed base of projects, spanning three decades
  - See our website for case studies and winners of the DALI Lighting Awards
- From small installations to major infrastructure projects
  - e.g. Crossrail in London, New York City Transit and Beijing Airport

- DALI is “the **largest wired digital open protocol** in the world for lighting.”
  - *Pål Karlsen, Omdia, LED Professional May/June 2020 issue, Link*
- “Open protocols will be the growth winners over the next few years in smart lighting and connected controls.”
  - *Ibid*
- “DALI is the **largest segment for smart lighting**, with **15% CAGR** expected over the next 5 years”
  - *Global Smart Lighting Market research report, Link*



DALI-2 certification

- DiiA drives the DALI-2 certification program
  - Ongoing work to add new features and new products types

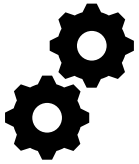
- DALI-2 certification involves **rigorous and detailed testing**
  - Approx. 3 days to test a DALI-2 LED driver
- Followed by **verification** of test results

→ **High confidence of interoperability** between products

- Allows **trademark use**
- Products are **traceable** in our online database

Based on open, global standards

Rigorous testing and verification



Cross-vendor compatibility

Benefits of DALI for lighting

DALI for dimming

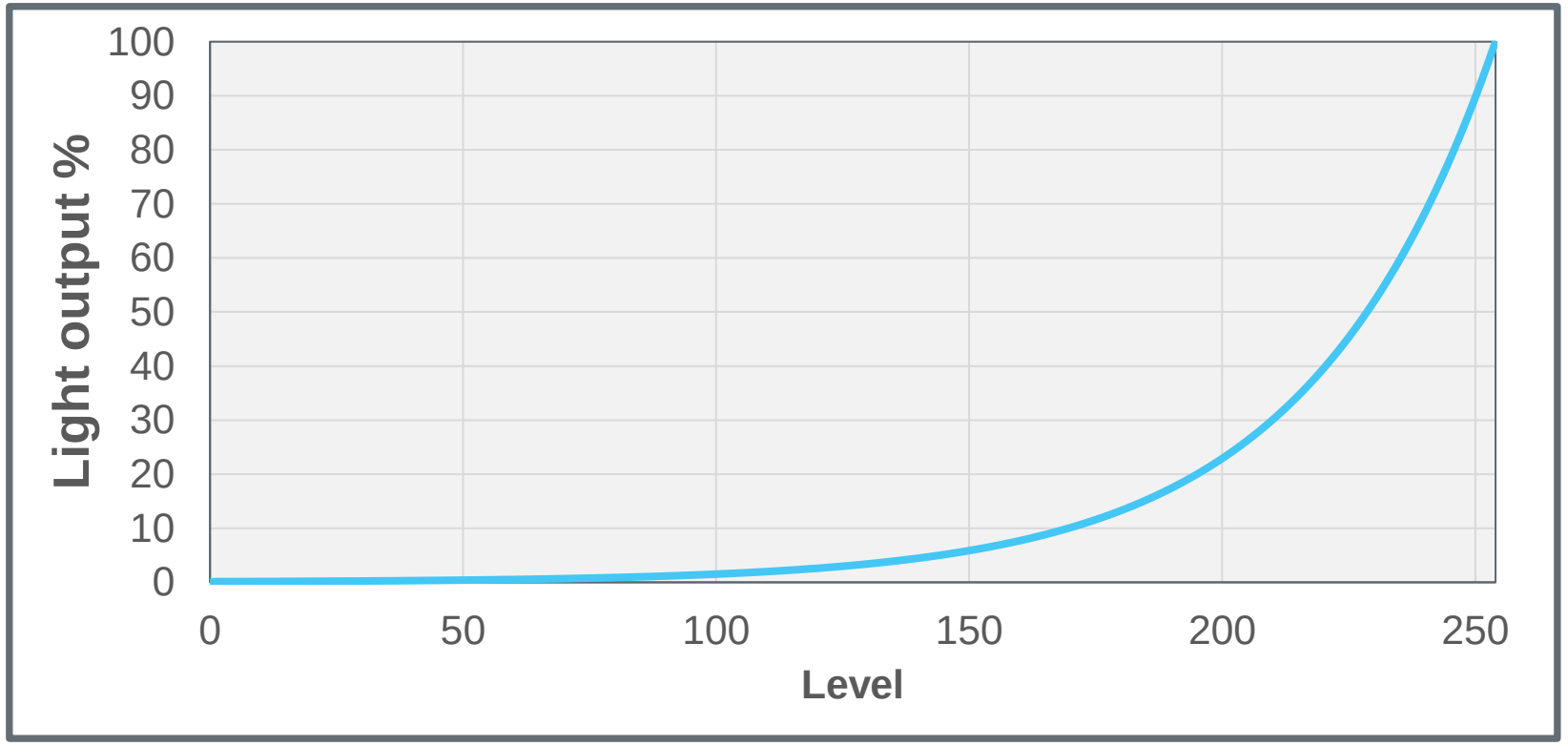
Accurate, repeatable, standardized light-output control

- Certified DALI-2 control gear follow a **standardized dimming curve**
  - Dimming curve is designed to match human-eye sensitivity and brightness perception
- Testing procedure requires **measurement of light output**

If you ask for 50% light output, you get 50%

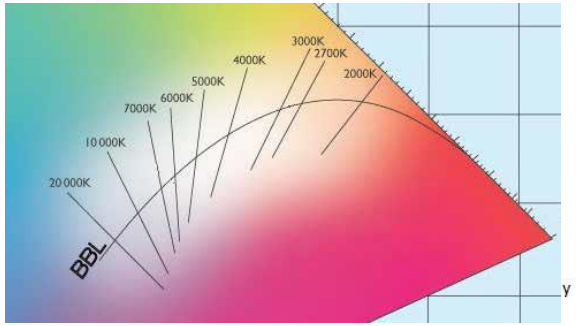
Consistent from fixture to fixture

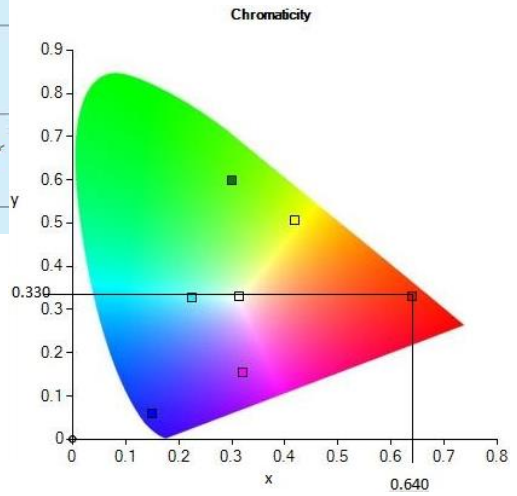
Consistent between manufacturers



DALI for colour control

- Enables control of the colour output of two or more lamps from DALI control gear
- Allows simple control of colour:
  - **RGBWAF** for individual control of each colour channel
  - **Tc (tunable white)** for colour-temperature control
- Allows precise and repeatable selection of colour:
  - **xy coordinate** (chromaticity)
- Allows **smooth fading** between colours
- For colour accuracy, xy and Tc colour types allow calibration





DALI-2 tunable white

- DALI-2 certification program now includes tunable white control
- Allows control of the correlated colour temperature (CCT) along the black-body line, from warm white to cool white
- Tunable White DALI-2 drivers implement colour type Tc of Part 209
  - Also known as DT8(Tc)
- DALI scenes allow recall and smooth fading of colour as well as brightness

NEW: DALI-2 certification of RGBWAF and xy colour types

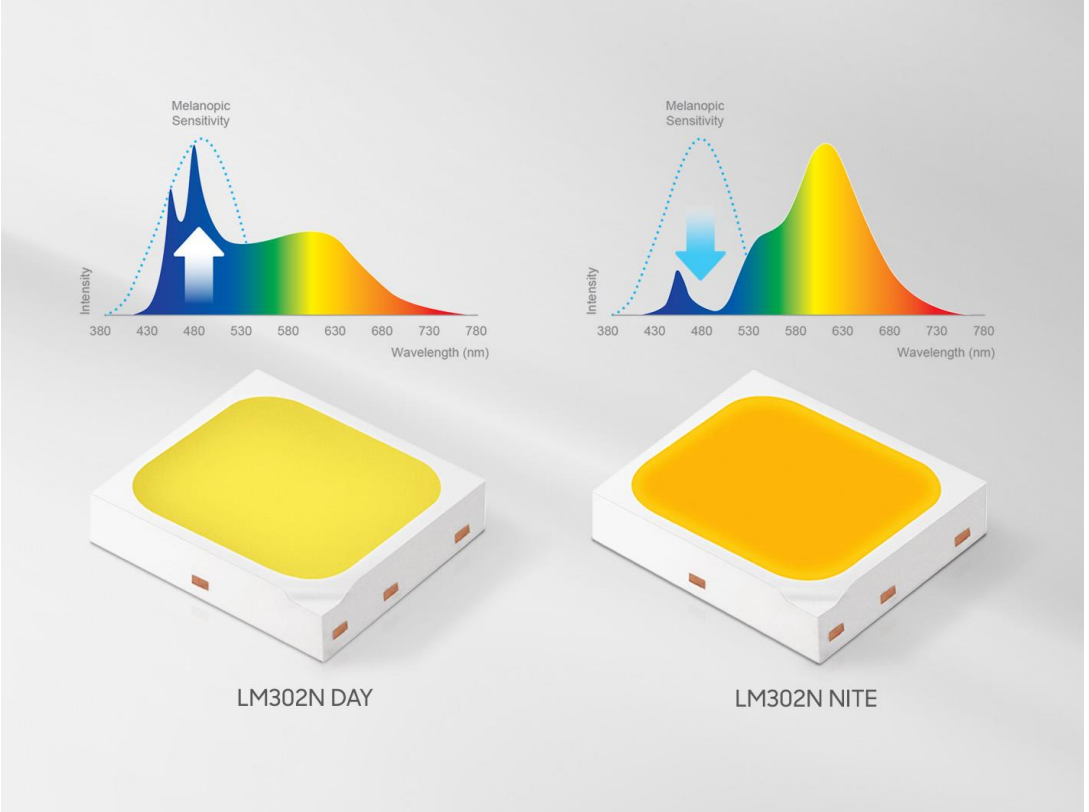


Image shows spectral light output from white LEDs. Cool (daytime) white on the left, warm white on the right. Source: Samsung Electronics (Link)

Forum Groningen, the Netherlands

- Ten-story multifunctional public building
- > 1,000 tunable white LED luminaires
- Tunable white DALI DT8(Tc) LED drivers
- Dimming to 0.1%
- Dynamic adjustment of CCT from 2500K to 4000K

- Source: eldoLED (Link)

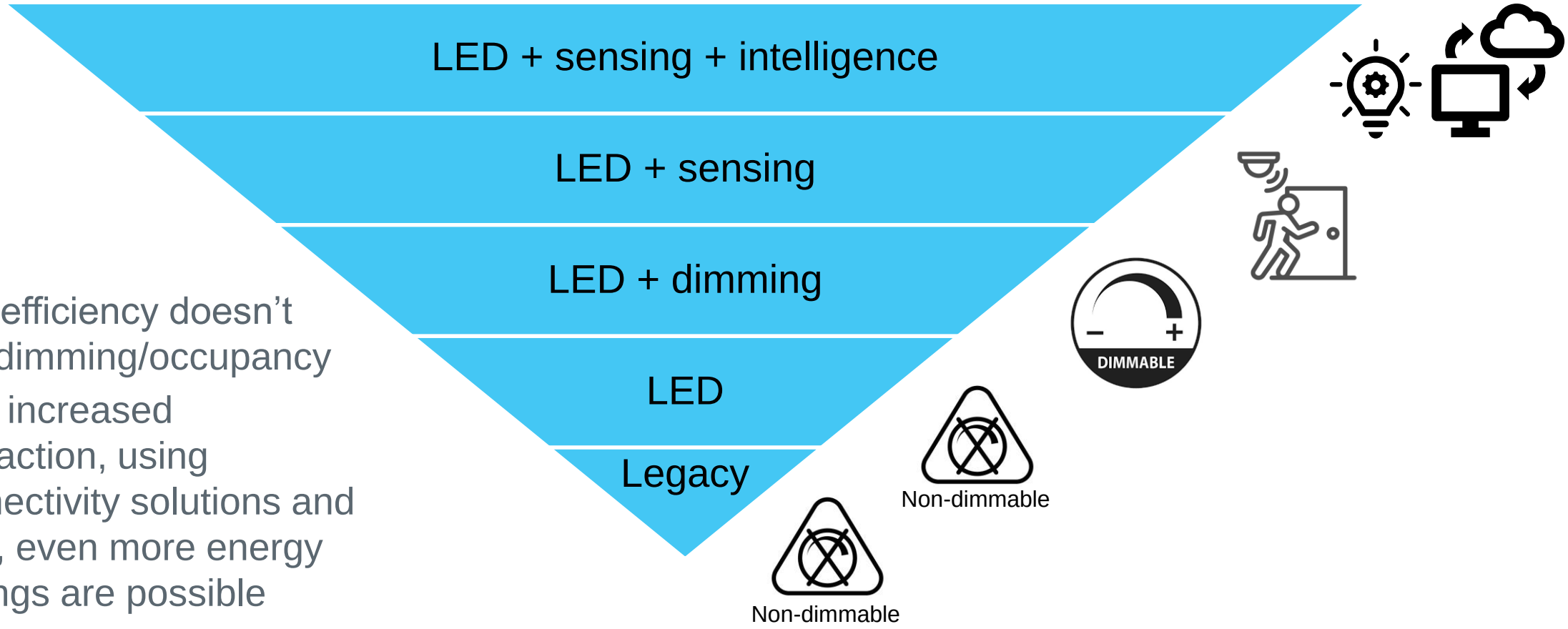
DALI for emergency lighting

- Widely used as a robust and reliable solution in buildings throughout the world
  - Provides light when the mains supply fails
  - Safety-critical feature mandated by various regulations
- DALI enables illumination and emergency lighting on the same network
- NEW: DALI-2 certification of control gear for self-contained emergency
  - “Self-contained” means the battery is inside, or placed next to, the luminaire
- DALI enables automated self-testing:
  - In many countries, there is a legal requirement for periodic testing of emergency lighting
  - Function test: quick test of the battery, charging circuit, driver/relay and lamp
  - Duration test: checks operation for the rated duration (for example: 1 h, 3h…)
- DALI provides data e.g. test results, information on failures, battery charge levels, lamp operating hours

DALI in smart buildings

DALI for energy efficiency

- DALI builds on energy efficiency gains from using LEDs and basic lighting control (switches, dimmers)



Energy efficiency doesn't stop at dimming/occupancy

- With increased interaction, using connectivity solutions and data, even more energy savings are possible

DALI for data

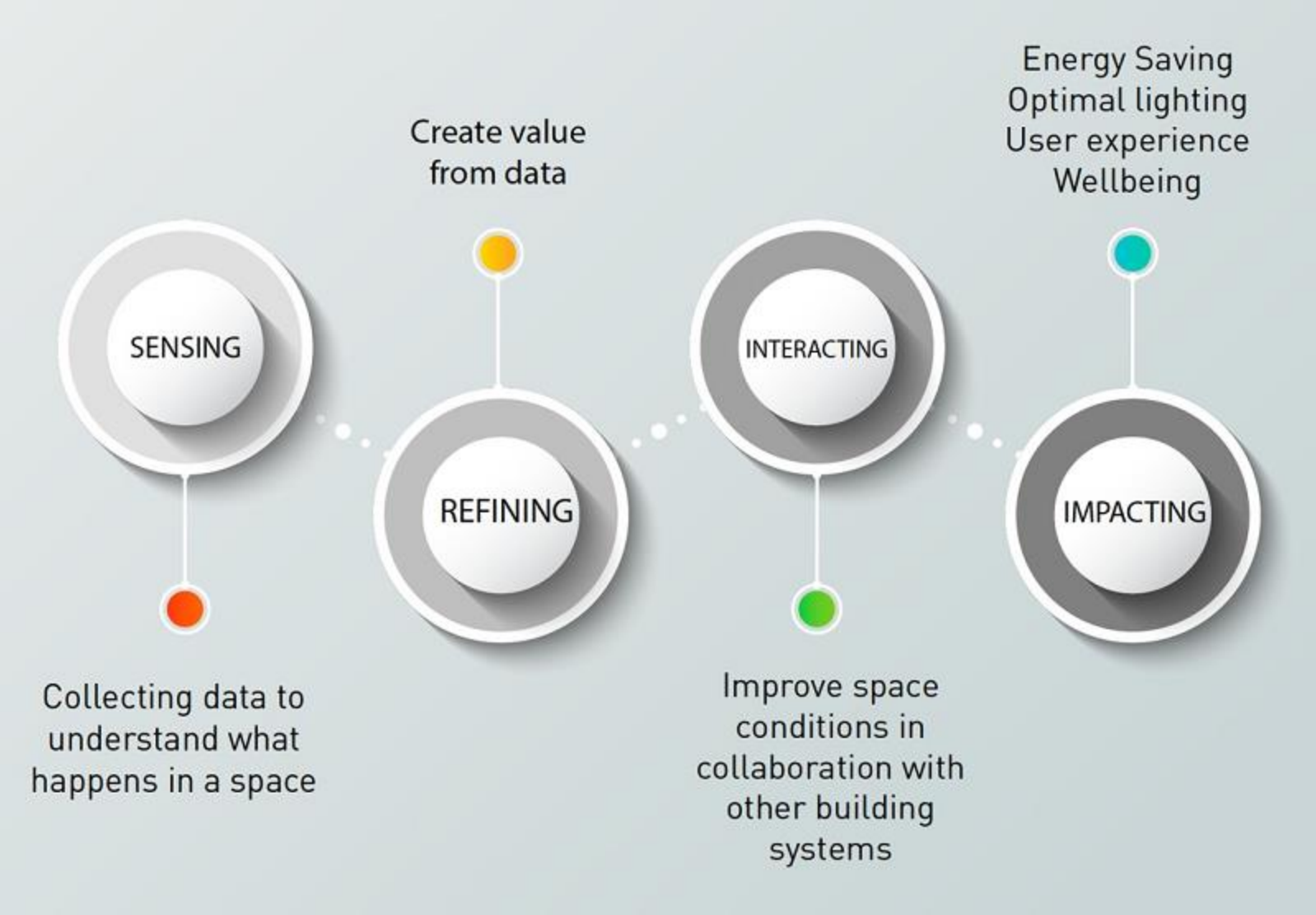
DALI is built to enable smart, data-rich networks

- Feedback & exchange of data is enabled by two-way communication
  - Control gear provide data on output level, lamp failure, emergency test data and more

- DALI-2 sensors and other input devices
  - Information and user inputs

- DiiA specifications for data storage and reporting
  - Data for enhanced asset management, performance monitoring & diagnostics
  - Data for luminaires, control gear & light sources

Elements of lighting intelligence



Source: Helvar

DALI-2 sensors & other input devices

DALI-2 Sensors

- Sensors provide information for automated control
- User inputs allow occupants to make adjustments
  - Dimming, colour, scene recall etc

- DALI-2 input device types include:
  - Push-buttons
  - Absolute input devices (switches, sliders, rotary controls)
  - Occupancy sensors (movement or presence type)
  - Light sensors (illuminance level)

- Other sensor types in development include:
  - Colour sensors
  - General-purpose sensors

- Operation can be event driven, or by polling, or by periodic transmission.

DALI data specifications

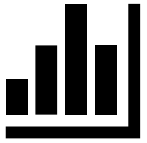
- Data for enhanced asset management & performance monitoring
- Data storage in DALI memory banks, with standardized format & locations

Luminaire Data

DALI Part 251 – Luminaire Data

- Information about the luminaire (e.g. GTIN, light output, CCT & CRI, light distribution etc) can be stored in the control gear
- Enables asset management

Energy Data



DALI Part 252 – Energy Reporting

- Provides real-time power & energy usage for control gear

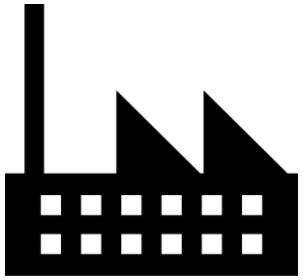
Diagnostics Data

DALI Part 253 – Diagnostics & Maintenance

- Operating data for control gear and lamps, including failure conditions, run-time data
- Enables predictive maintenance

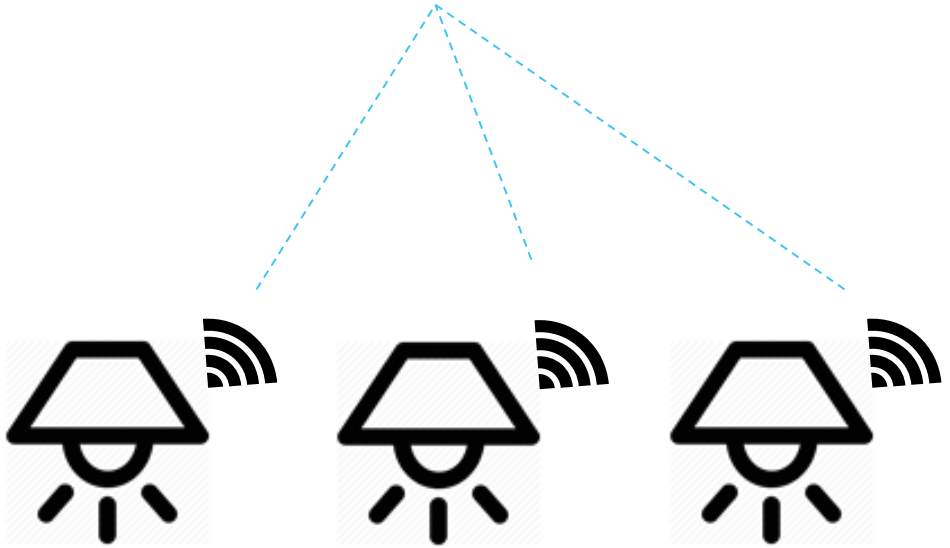
These specifications are available from DiiA, and are also included in ANSI C137.4

Using DALI data



In the factory:
Luminaire data is programmed into drivers

Network



In the field:
Automated commissioning
- When installed, luminaires can automatically transfer data to a remote network
- Reduces human error, saves installation time and cost
- Operator has a full map of asset information

During operation:
Performance monitoring
- Energy usage data can be used e.g. for billing

During operation:
Predictive maintenance
- Diagnostics data allows network operator to anticipate need for maintenance
- Repair team has knowledge of location and type of fixture

DALI for wellbeing and comfort

Efficient, human-centric lighting

- Daylight harvesting: adjust intensity according to ambient light levels through the day
  - DALI-2 light-level sensors
- Match lighting levels to actual utilization of spaces
  - DALI-2 occupancy sensors
- Colour-temperature control according to time of day and/or individual preference
  - DALI-2 tunable white
- Personal control of lighting via user interfaces
  - DALI-2 input devices such a push-buttons, rotary controls or touch panels

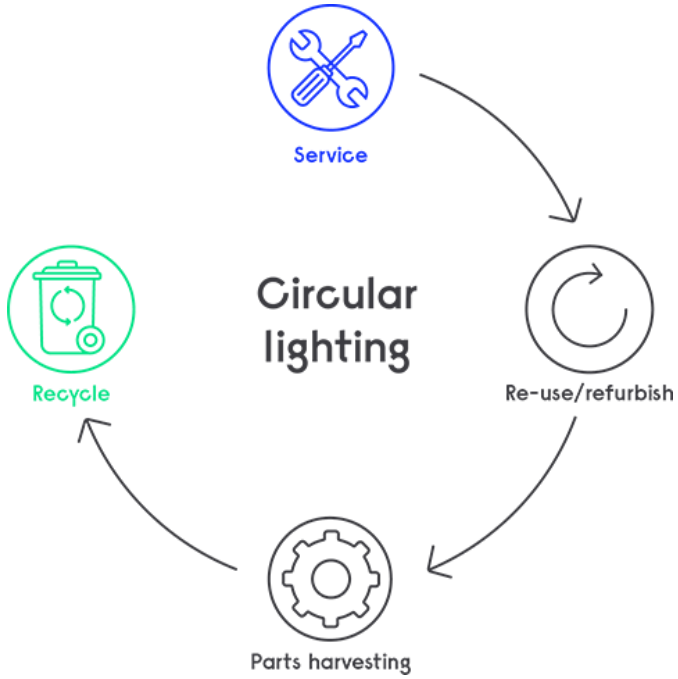
- Building occupants experience improved comfort and wellbeing
  - Higher productivity, better staff retention

DALI and the circular economy

- DALI enables modular systems/designs
  - Enables components to be interchangeable
  - Certified, interoperable

- Replacement components from multiple sources enable supply-chain longevity
  - Removes supply-chain constraints: Not reliant on single supplier
  - Future-proof by backwards compatibility

- DALI enables the potential to extend the lifetime of luminaires and luminaire designs
  - Easily upgradeable
  - Plug and Play if socketed and standardized e.g. Zhaga-D4i



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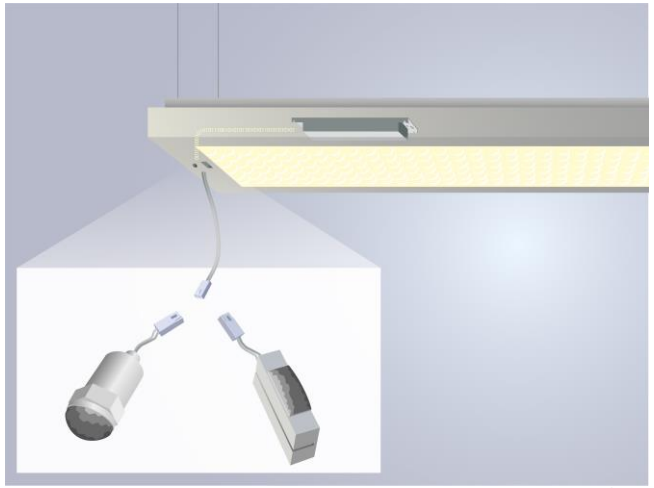


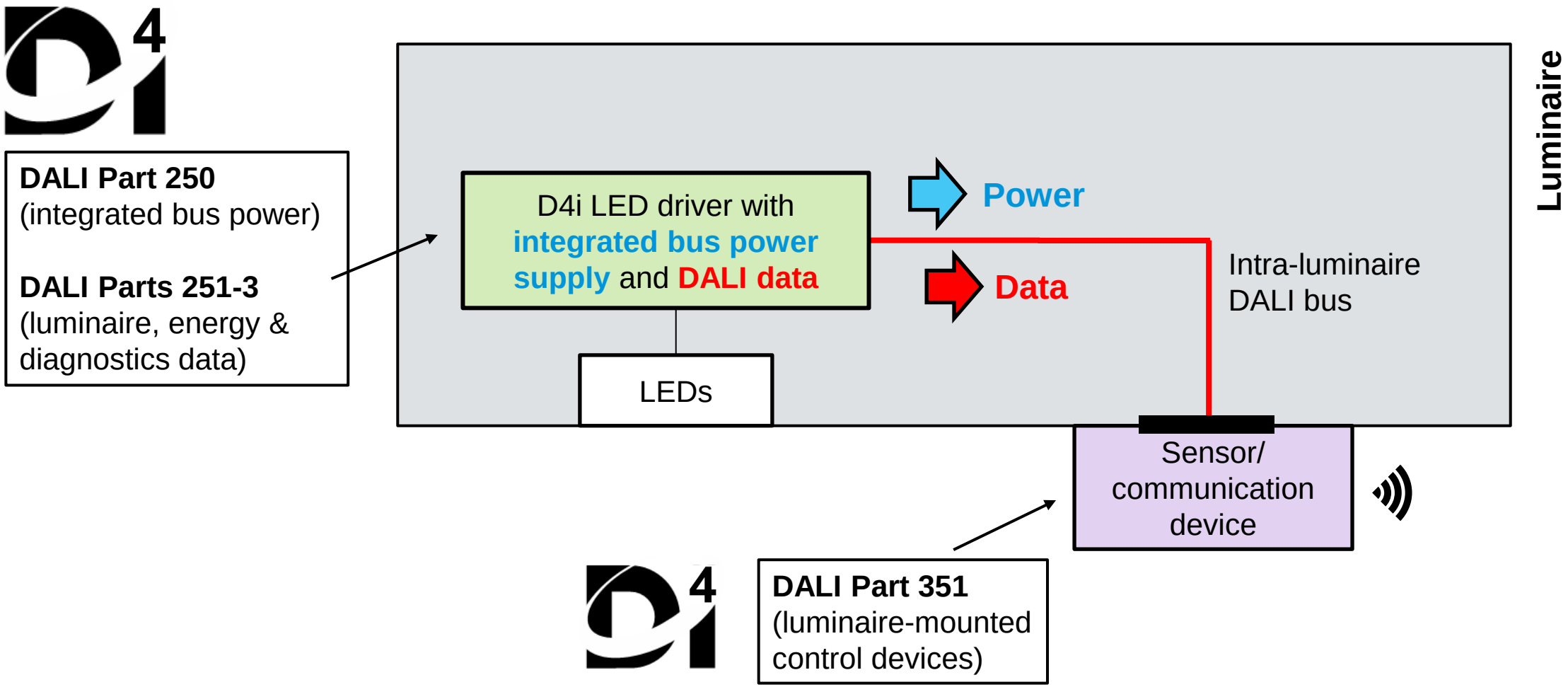
Source: Zhaga

D4i and IoT luminaires

D4i overview

- D4i is an extension of DALI-2 certification
- D4i components have a compulsory set of features
  - Based on power-supply and data specifications from DiiA
- All D4i LED drivers provide luminaire, energy & diagnostics data
- D4i enables DALI inside intelligent, IoT-ready luminaires
  - Other D4i implementations are also permitted
- D4i simplifies addition of sensors and communication devices to luminaires
- D4i enables plug-and-play interoperability when combined with a connector system
  - e.g. Zhaga Books 18 & 20, or NEMA/ANSI

D4i example: Indoor luminaire



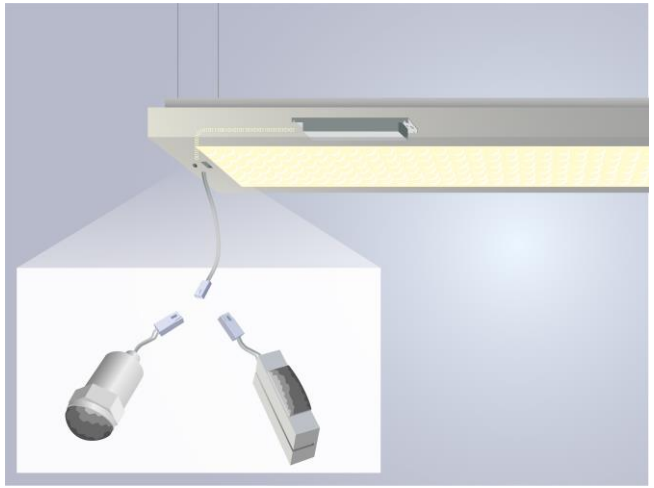
Zhaga-D4i certification

A joint certification program based on complementary specifications

Specifications from DiiA enabling D4i certification

Book 18 & Book 20 specifications from Zhaga

DALI Part 250: Integrated bus power supply
DALI Part 251: Luminaire data
DALI Part 252: Energy data
DALI Part 253: Diagnostics data
DALI Part 351: Luminaire-mounted control devices
DALI Part 150: AUX power supply



Book 18 for outdoor:
Book 20 for indoor:

- Mechanical interfaces
- Electrical pin assignment (Book 18)
- Electrical connectors (Book 20)
- References to D4i specs for power & control, and luminaire tests

Connectivity

DALI in an IoT world

How does DALI fit with this simple IoT definition?

- IoT: A system of devices with unique identifiers and ability to transfer data over a network

Addressing	DALI devices are individually addressable
Data exchange	Data exchange is inherent in DALI, due to bi-directional communication
Connectivity	Multiple current & emerging options, including wireless

DALI is already positioned to participate in the Internet of Things

DALI in an IoT world – Connectivity

Current DALI capabilities:

- Multiple DALI subnets can be networked together, for building-wide control
  - A single application controller can control multiple DALI subnets
  - Several application controllers can be connected together via a backbone e.g. Ethernet-based

- DALI systems can connect with other networks via non-standardized gateways
  - e.g. Gateways connecting with building-management systems (BMS)

- D4i facilitates addition of wireless nodes (network lighting controllers) to luminaires
  - Standalone luminaires can participate in remote lighting-control networks

Emerging DALI capabilities:

DALI connectivity via wireless networks

DALI connectivity via IP-based networks

DALI in a wireless world

Two distinct solutions for combining DALI with wireless networking

Wireless to DALI Gateways	Wireless DALI
Gateways allow existing DALI wired products to be used in a non-DALI wireless ecosystem	Devices communicate using existing DALI commands, carried over a wireless medium

- DALI Alliance has developed **new specifications** addressing **both options**
- We are developing tests to enable certification programs, in collaboration with partners:

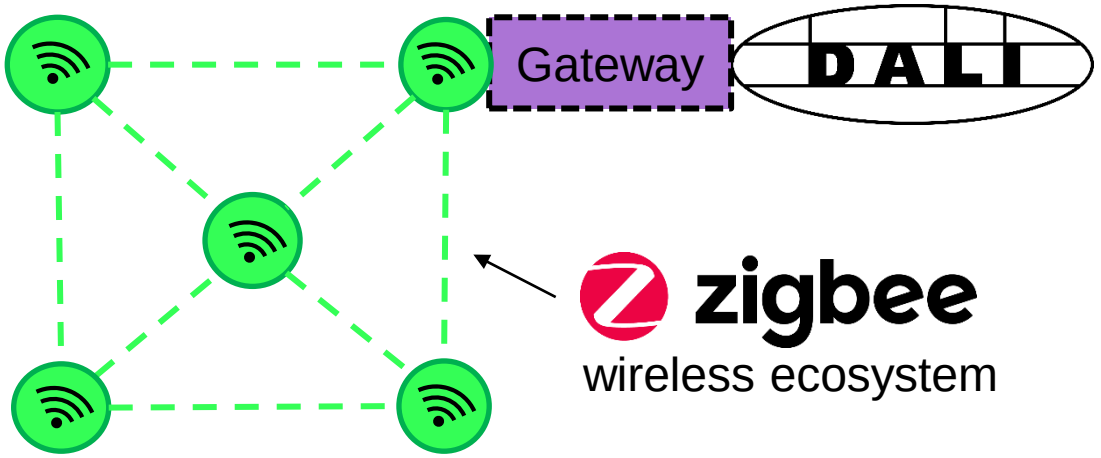
Bluetooth®

csa connectivity standards alliance

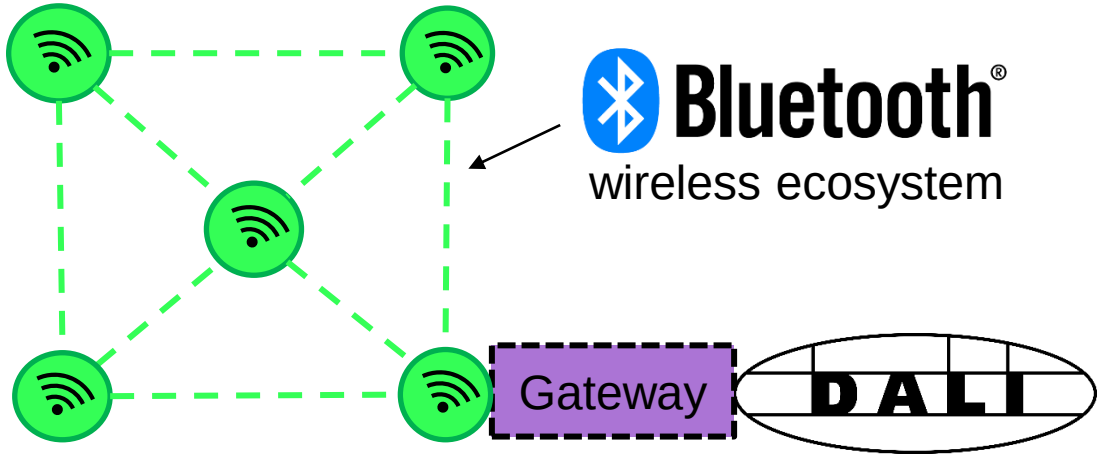
THREAD GROUP

Wireless solutions for DALI

Wireless to DALI Gateways



zigbee
wireless ecosystem

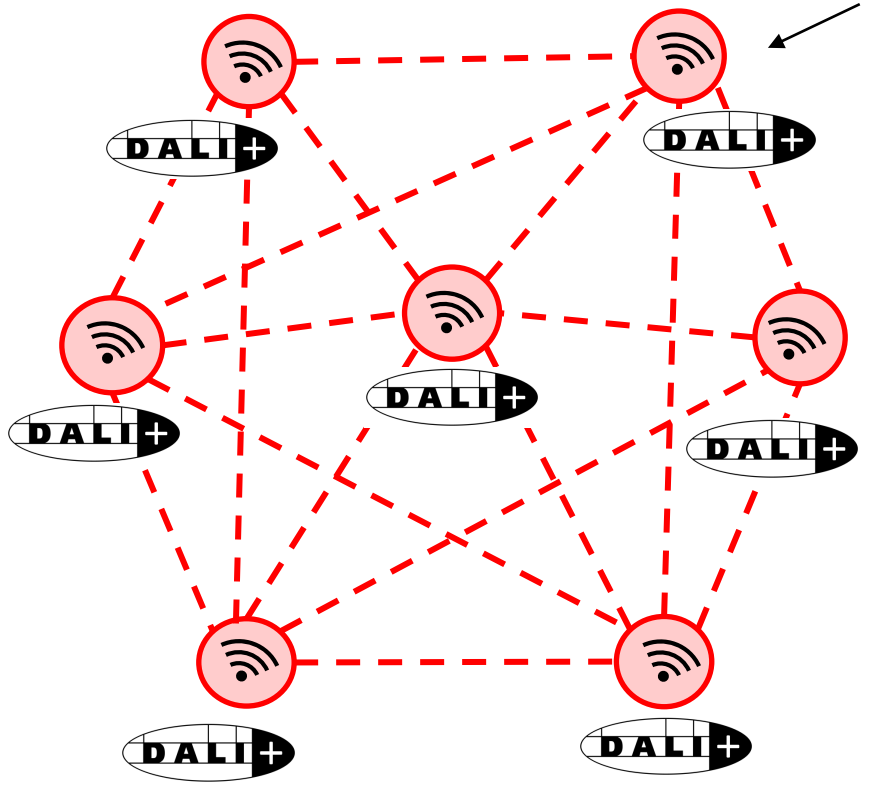


Bluetooth®
wireless ecosystem

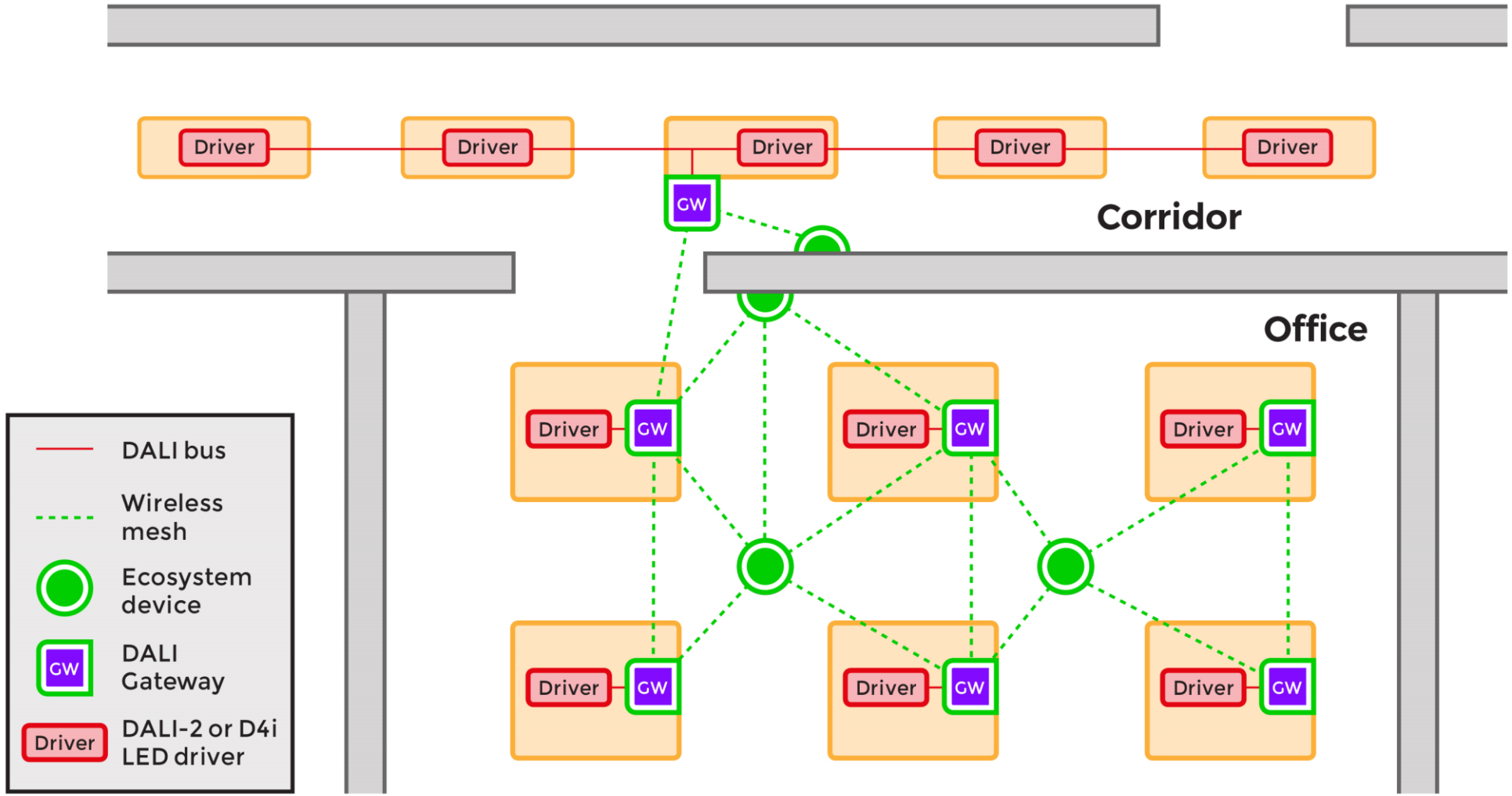
Wireless DALI

DALI+™

Wireless DALI+ devices in a mesh network



Wireless to DALI Gateways – Implementation



Introducing DALI+

DALI lighting control
plus
wireless and IP-based networking

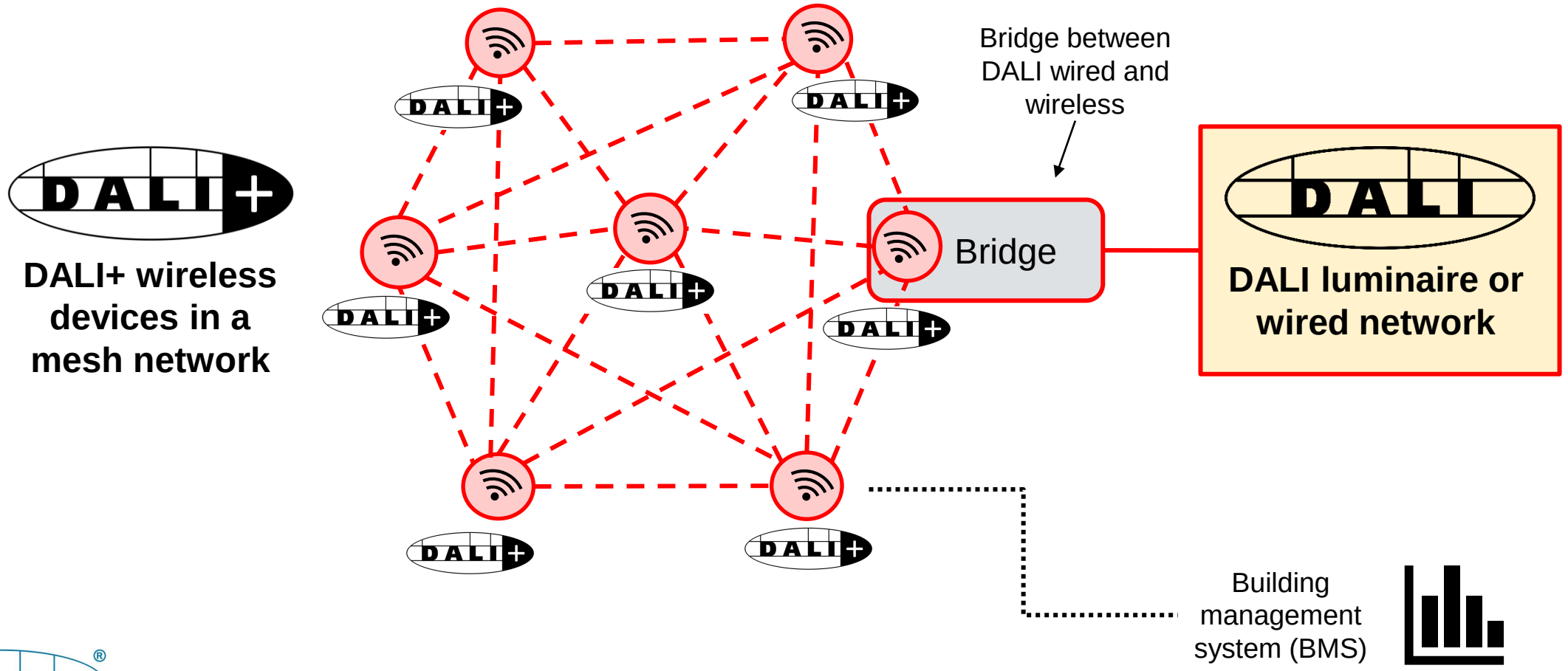
- DALI+ devices communicate using existing DALI commands, carried over a wireless and/or IP-based physical medium
  - Different from the dedicated pair of wires used by DALI-2 and D4i

- New DiiA Specification supports DALI+ with IP-based carriers e.g. Thread, Ethernet, Wi-Fi
- We are developing tests → “DALI+ with Thread” certification

- Same sophisticated DALI lighting-control features as wired (DALI-2 & D4i) options
- Same access to rich set of data from control gear, luminaires and sensors
- Additional addressing features

DALI+ over Wireless – Bridges

- Bridges allow access to DALI wired luminaires or subnets, from the DALI+ wireless network
- DALI commands are used throughout, and there is no translation between protocols



IP-BLiS (IP for Building & Lighting Standards)

- Internet Protocol for Building & Lighting Standards
- A marketing organization (not a new standards organization)
- Goal: to make commercial buildings more responsive to the needs of users by promoting a secure, multi-standard, IP-based harmonized IoT solution

IPBLiS

STANDARDS JOINING FORCES

BACnet International

csa connectivity standards alliance

DALI Alliance

KNX

OPEN CONNECTIVITY FOUNDATION

THREAD GROUP

DALI+™

DALI+ with Thread is an IP-based, wireless solution

Today: Building technologies in silos

There are more connected devices in Smart Buildings every day.

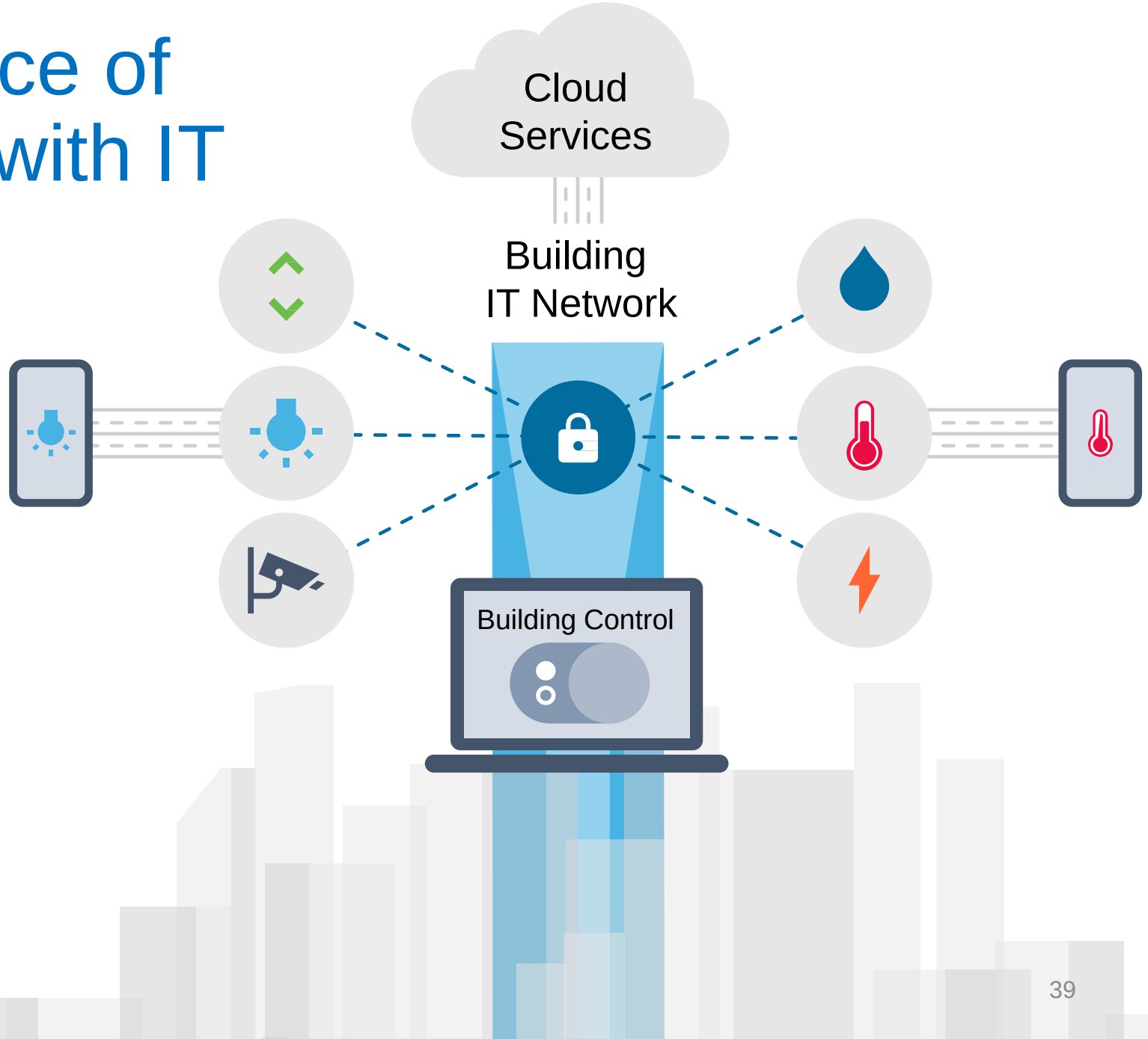
Each system evolved independently with its own proprietary solutions.

Trend: Convergence of Building Systems with IT

Facilitates IoT for commercial buildings.

No silos.
No proprietary applications.

Allows multiple systems to communicate together using cloud services & cloud computing.



Conclusions

- DALI makes a significant contribution to intelligent buildings:
  - Energy efficiency
  - Data monitoring and reporting
  - Future-proofing
  - Wellbeing and comfort of occupants
  - Predictive maintenance
  - Circular economy

- Standardization and certification increases confidence in cross-vendor interoperability

- New specifications enable:
  - DALI over wireless and IP-based connectivity options
  - Gateways to other wireless ecosystems

DALI Lighting Awards 2021

- Deadline: October 31, 2021
- Entry criteria and submission form: www.dali-alliance.org/awards2021

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Thank you !!

DALI® Alliance