

Data-rich DALI networks and wireless connectivity

– ZVEI Connected Lighting Day

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Agenda

Data-rich DALI networks and wireless connectivity

- Introduction: DALI, DALI-2, D4i, DALI+ and the DALI Alliance
- Update on IEC 62386 and DALI-2 certification
- Products, systems and luminaires
- Data and measurements available from DALI
- Connectivity – wireless and IP solutions



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DALI: The basics




Digital Adressable Lighting Interface

- 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



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
- Around **350 members** worldwide
 - Industry leaders in lighting and control
 - Full list on our [website](#)
- Membership allows certification of products:
 - Over **3,200 DALI-2 certified products**
 - Over 1,600 DALI version-1 registered products
- Membership allows DALI, DALI-2, D4i and DALI+ trademark use.



IEC 62386 – Updates

Recent publications

- 101: System – updated to edition 3
- 102: Control gear – updated to edition 3
- 103: Control devices – updated to edition 2
- 150: AUX power supply – new (originally from DiiA)
- 202: Self-contained emergency control gear – updated to edition 2
- 250: Bus power supply memory bank – new (originally from DiiA)
- 251: Luminaire data – new (originally from DiiA)
- 252: Power and energy data – new (originally from DiiA)
- 253: Diagnostics data – new (originally from DiiA)
- See: [IEC webstore](http://www.iecwebstore.com)

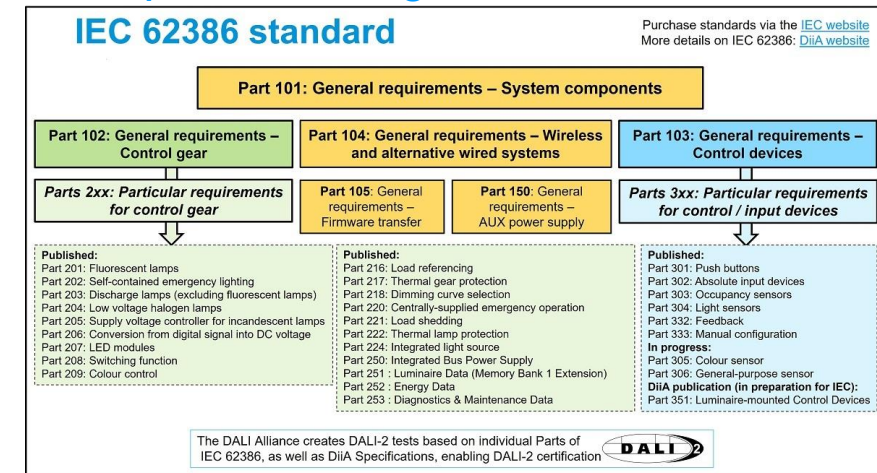
In progress

- 104: Wireless and alternative wired – AMD1
- 105: Firmware transfer – edition 2
- 209: Colour control gear – edition 2
- 305: Colour sensor – new part
- 306: General purpose sensor – new part provided by DiiA
- 351: Luminaire-mounted control devices – new part, provided by DiiA
- 254: Extended emergency data – new part being developed by DiiA



Overview available at:

<http://DALI2.org/dali/standards.html>



DALI Alliance – Certification updates

Parts already included in DALI-2/D4i certification:

- 101, 102, 103, 150
- 202, 205, 206, 207, 208, 209, 224, 250, 251, 252, 253
- 301, 302, 303, 304, 351

In progress

- 104: DALI+ with Thread
- 105: Firmware transfer
- 202: Self-contained emergency lighting – updates for edition 2
- 220: Centrally-supplied emergency lighting
- 332: Feedback (control devices)
- 341 & 342: Gateways for Bluetooth Mesh and Zigbee



DALI – Products, systems and luminaires

Three basic types of products make up DALI systems:

- **Control gear:** directly provide power to the lamps
- **Control devices:** *Application controllers* send commands to control gear, and *input devices* provide information to the system (e.g. occupancy sensors)
- **Bus power supplies:** Provide power to the DALI bus, allowing communications and for bus-powered products.

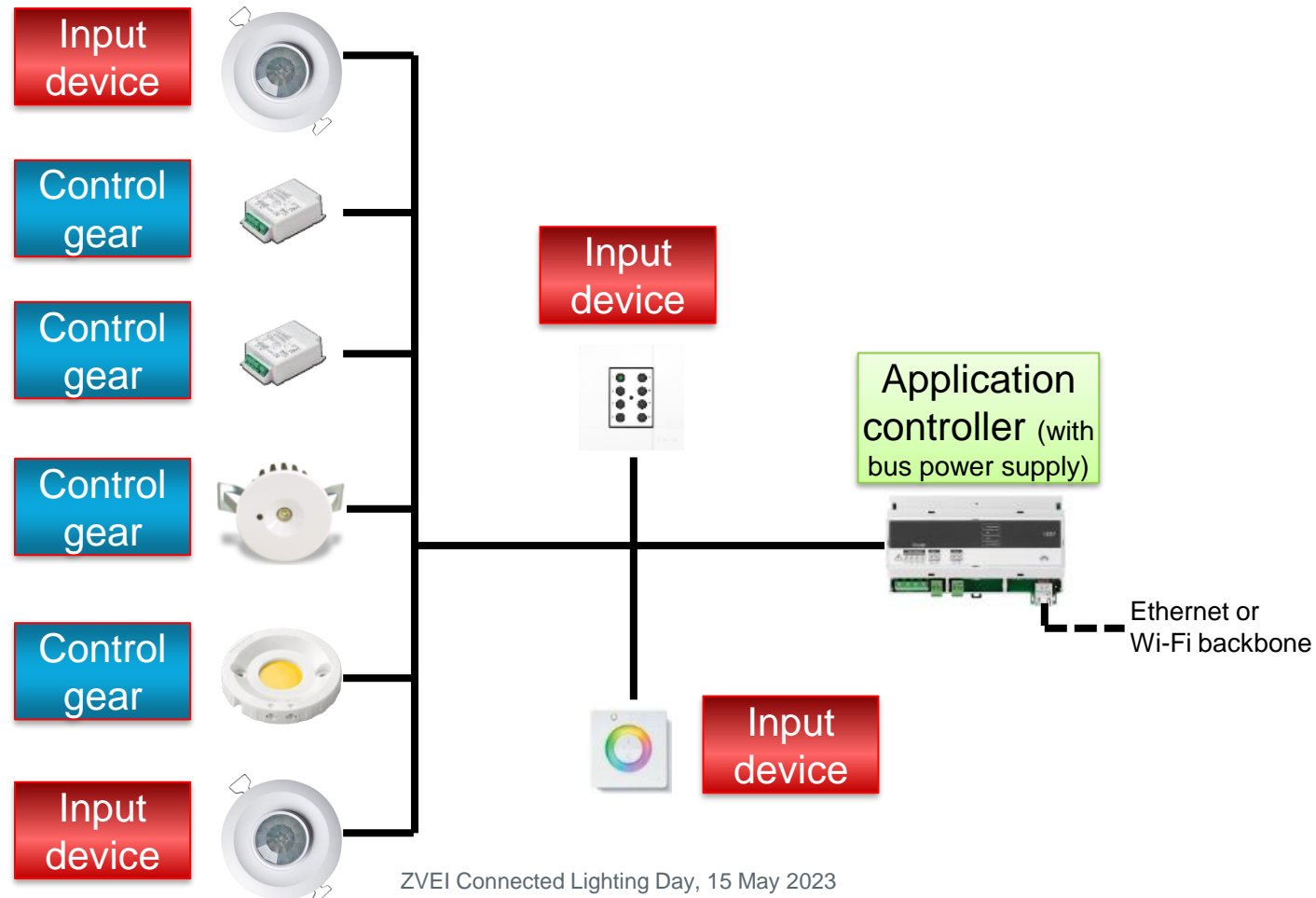


These are connected together into DALI systems:

- **Systems with multiple luminaires** connected to the DALI bus.
- **Intra-luminaire systems** where the control gear and control devices are in or attached to the luminaire, forming a small DALI system.

DALI systems

- Up to 64 control gear and 64 control devices can communicate on a single DALI bus.
- Larger systems use multiple DALI networks, often joined using a backbone such as Ethernet or Wi-Fi.



D4i – Intra-luminaire DALI system

D4i is an extension to DALI-2:

- D4i control gear (drivers) include a mandatory set of functionality
- D4i control devices include functionality to aid “plug & play”
- Luminaires require one to four D4i drivers.
 - Especially for intra-luminaire use: DALI is inside the luminaire
- All D4i LED drivers provide luminaire, energy & diagnostics data
 - Enables DALI inside intelligent, IoT-ready luminaires
 - Some D4i drivers also provide colour control or emergency lighting
- D4i simplifies the addition of sensors and communication devices to luminaires
- D4i enables plug-and-play interoperability when combined with a connector system
 - e.g. Zhaga Book 18 & 20 or NEMA/ANSI C136.41

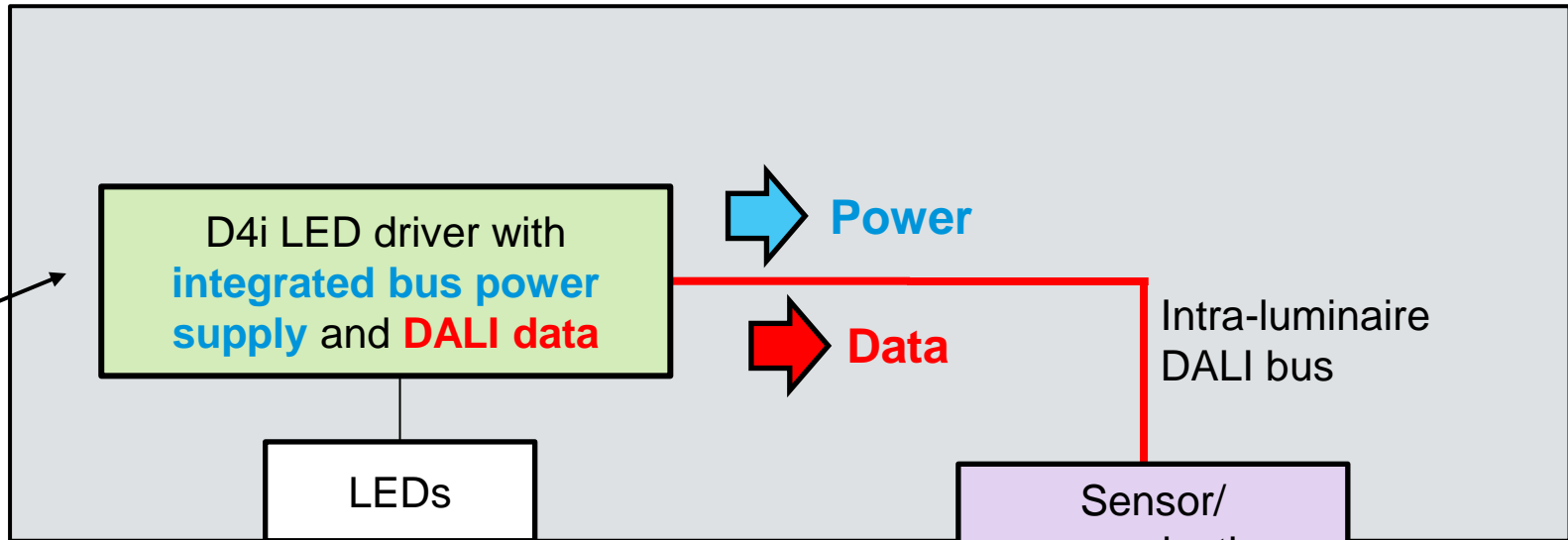


D4i example luminaire



DALI Part 250
(integrated bus power)

DALI Parts 251-3
(data for enhanced asset tracking & performance monitoring)



DALI Part 351
(luminaire-mounted control devices)

What data is available from control gear?



- **Output level** and **lamp failure** have been available since the start of DALI
- Emergency control gear added battery and test information
- Parts 251, 252 and 253 provide data for enhanced asset management & performance monitoring:



Luminaire Data

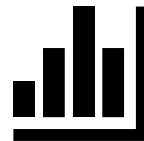


DALI Part 251 – Luminaire Data

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



Energy Data



DALI Part 252 – Energy Reporting

- Provides real-time power & energy usage for LED drivers



Diagnostics Data

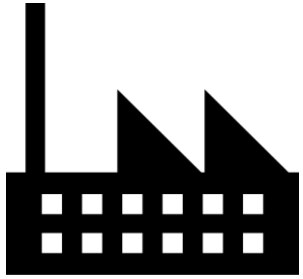


DALI Part 253 – Diagnostics & Maintenance

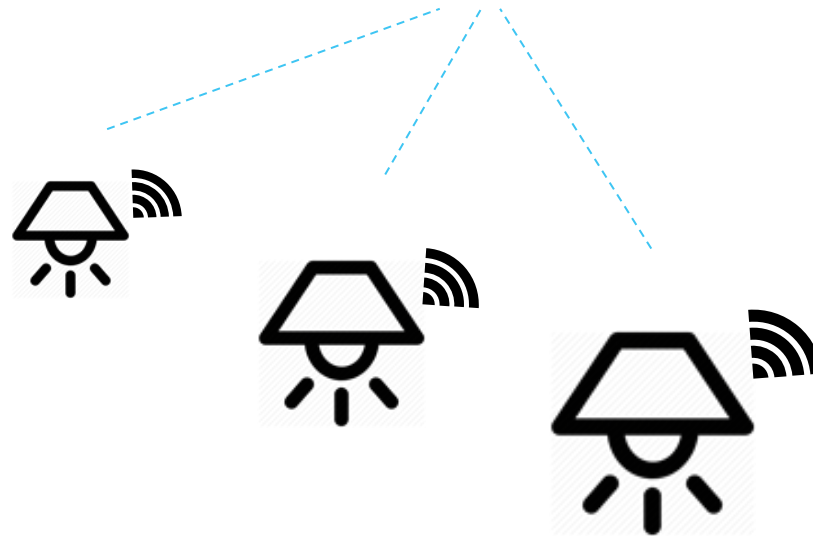
- Operating data for control gear and lamps, including failure conditions, run-time data
- Enables predictive maintenance

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

Using DALI data: Example



In the factory:
Luminaire data is programmed into drivers.



During operation:
Performance monitoring

- Energy usage data can be used e.g. for billing



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:

Predictive maintenance



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

What data is available from control devices?



- **Existing control devices (input devices):**
 - **Parts 301** (push-button) and **302** (absolute inputs) can be used for digital and analogue measurements, with part **303** for occupancy or presence, and part **304** for light measurement.
- **New input devices:**
 - **New part 305** (in progress) provides RGB colour sensor measurements.
 - **New part 306** (in progress) standardises many different types of measurements (details on following pages).
- **Obtaining measurements:**
 - Measurement event messages can be triggered automatically when the measurement changes
 - Measurement event messages can be periodically transmitted.
 - Measurements can be polled by an application controller.

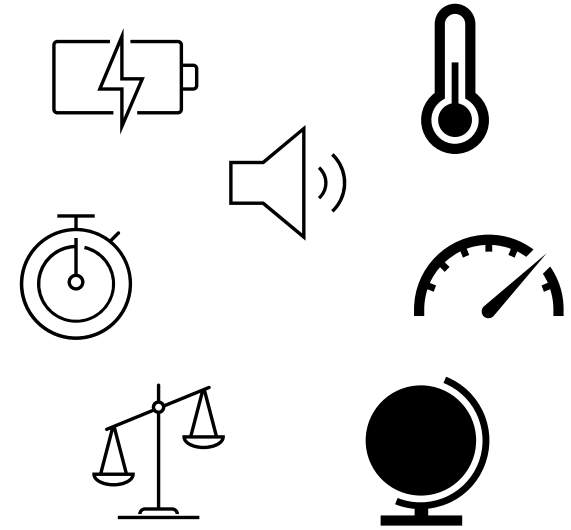
Part 306 – General purpose sensor

- In the final stages with IEC (FDIS being prepared)
- Allows measurement of many **physical quantities**, with a selection of **units**
- Further quantities and units can be added in the future.
- Features include:
 - scale factor in powers of 10
 - Event driven notifications, with hysteresis, and alarms
 - Choice of measurement resolution
 - Unipolar and bipolar measurements
 - Capture of min and max measurements
 - Multiple configurable alarm levels
 - Implemented in the same way as other DALI input devices, allowing multiple instances within the same device (one logical unit uses only one short address and supports 32 instances)



Part 306 – General purpose sensor

- **Measurement quantities** include:
 - Time, frequency
 - Length, area, volume
 - Weight, mass
 - Angle/tilt
 - Torque
 - Energy, power, power factor, voltage, current, battery charge
 - CCT, CRI, Red, Green, Blue
 - Temperature, wet bulb temperature, humidity (rel. & abs.), dew point
 - Pressure, flow rate
 - SO₂, CO₂, CO, VOC, NO_x, N₂O, NH₃, O₃, Cl, CH₄, acidity (pH)
 - Velocity, wind speed, sound pressure level, fluid level, Particulate matter (PM_x), air quality, GPS position, altitude, RSSI (various beacons)
- Once published, a list of additional measurements will be maintained by DiiA and submitted to IEC as amendments, at appropriate times.



Part 306 – General purpose sensor

- **Units** include:
 - Dimensionless, %, ‰, ‰‰, ppm, dB
 - s, Hz
 - m, ft, m², m³, m/s, m/s², m³/s, m³/kg, Nm, kg/m³, kg/m²
 - V, A, J, W, C, F, Ω, S, Wb, T, H, A/m, V/m, Ah, Wh
 - K, °C, °F
 - degree ° (angle), rad, sr
 - N, Pa, mol, Bq, Gy, Sv, kat
 - lm, lx, cd, cd/m²
- Once published, a list of additional units will be maintained by DiiA and submitted to IEC as amendments, at appropriate times.

°C Hz
m³ ppm

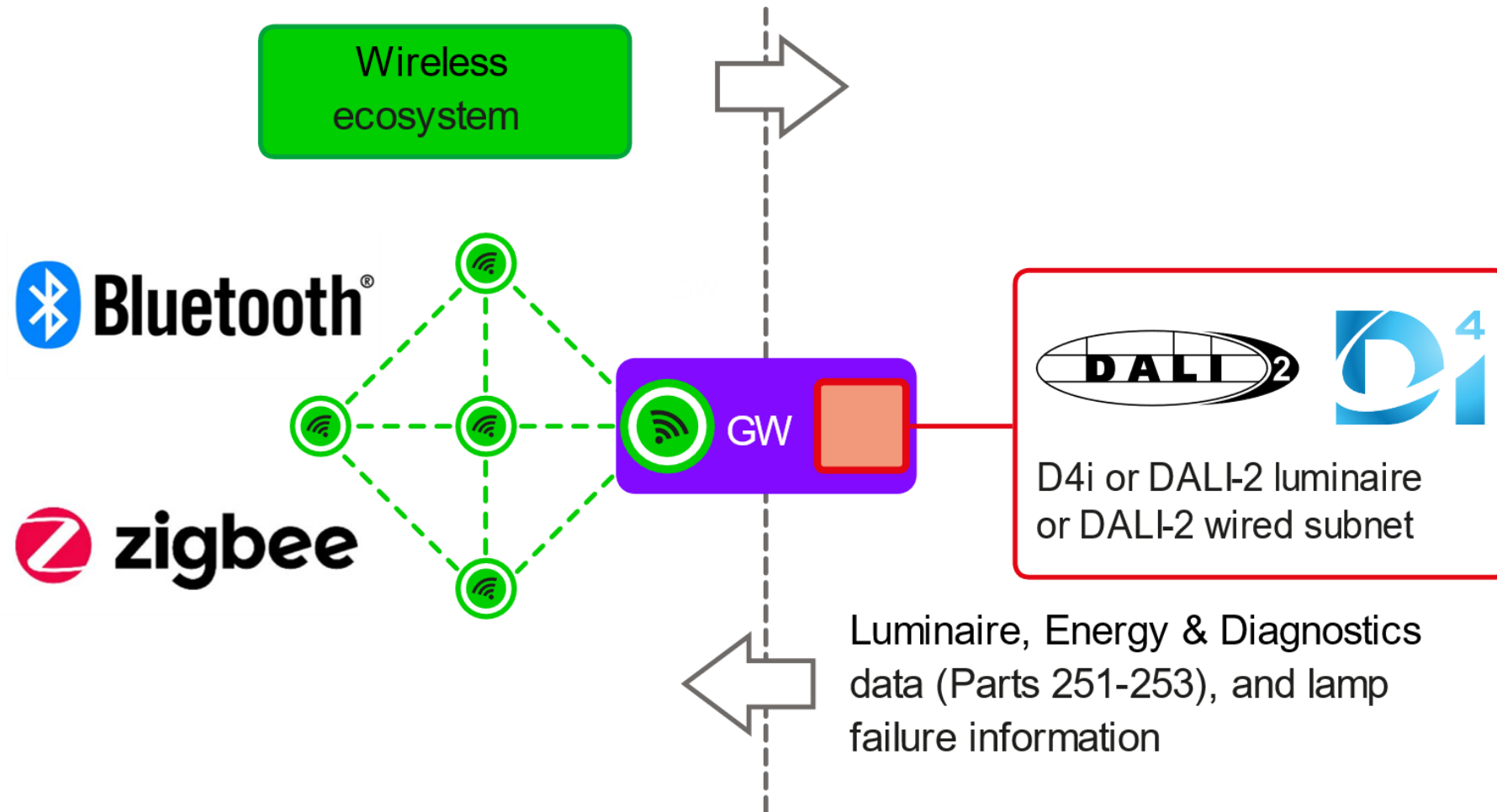
Wireless solutions: DALI gateways



Two DALI gateways are being added to DALI-2:

- Part 341: Bluetooth mesh gateway
- Part 342: Zigbee gateway
- These allow devices in the Bluetooth mesh or Zigbee “ecosystem” to control the DALI-2 or D4i lighting, and to obtain data from the connected DALI-2 or D4i system.
- Data transferred by the gateways includes the lamp failure state, luminaire data, power and energy, and diagnostic data.

DALI gateway example



Wireless solutions: DALI+

DALI+ is a wireless and/or IP based solution for DALI

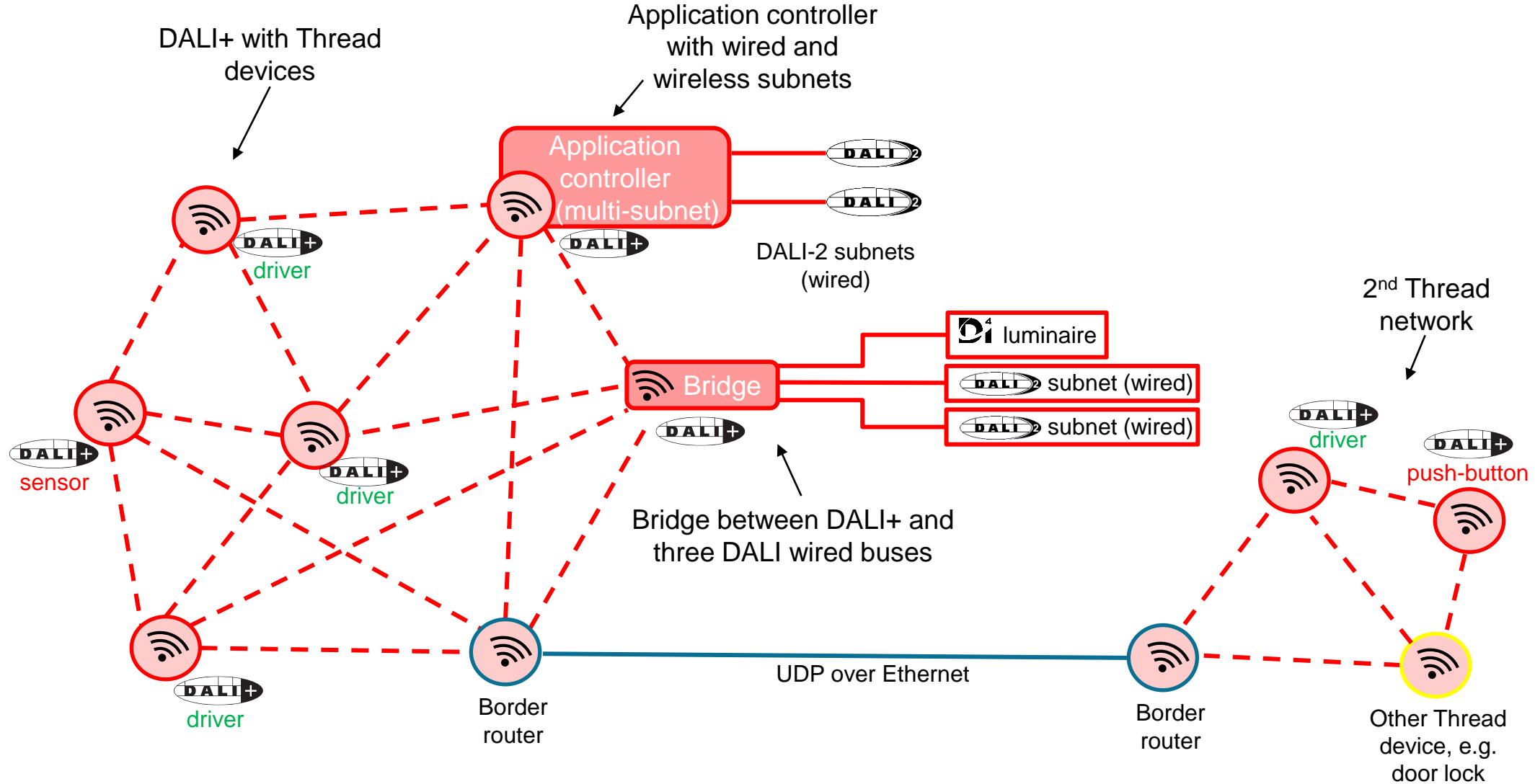
- Initially, DALI+ will use **Thread** as the wireless carrier
- Other carriers may be added in the future.

- **Thread**
 - Thread is an IPv6 solution
 - Thread devices form a wireless mesh network
 - Border routers allow the use of Wi-Fi or Ethernet to carry the packets of data.

- **DALI+ with Thread**
 - The existing DALI commands and data are transported by the wireless or IP-based carrier. This means that all data available for all parts of the standard are also available with DALI+.
 - IEC 62386-104, with DiiA additions and changes, describes how DALI frames are transported by the wireless carrier.
 - DiiA has added **bridges** to the specification, allowing DALI-2 systems or luminaires to be connected to the DALI+ system.
 - An example is shown on the next page.



DALI+ system example



Accessing the data from wireless systems



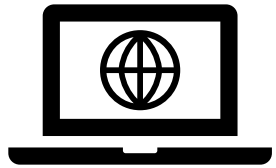
DALI+

- Data from all DALI+ devices, as well as DALI-2 and D4i devices connected through a bridge, is available to DALI+ application controllers.
- The application controllers can make it available to other systems.
- Thread uses IP, so the data can also be obtained through a border router that sits in-between the DALI+ system and a device such as a computer that connects through Ethernet or Wi-Fi.

Gateways

- Gateways can access much of the data in D4i drivers, or DALI-2 drivers that implement parts 251, 252 and 253.
- This data is made available to the wireless ecosystem.

Contact



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