DALI Connectivity & Networking

DALI® Alliance

DALI®2

D4™

DALI+™

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
Networking	Multiple current & emerging options, including wireless & IP

DALI is already positioned to participate in the Internet of Things

DALI in an IoT world – Networks

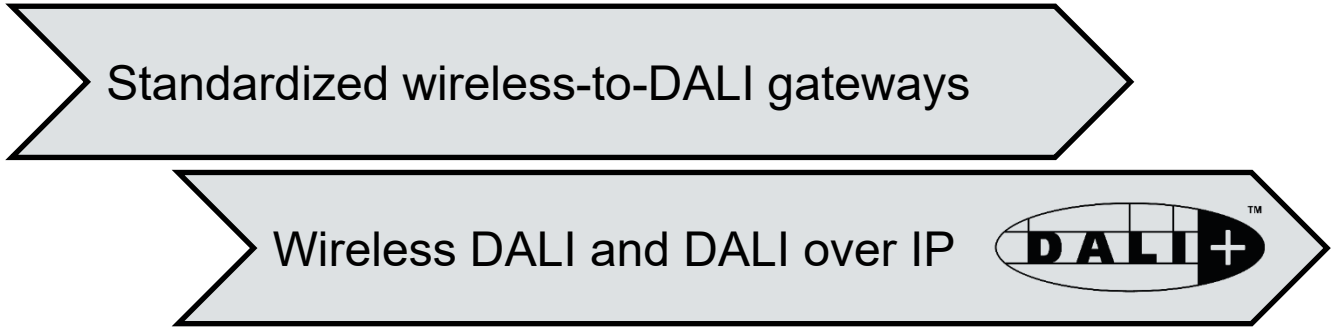
Current DALI capabilities:

- 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

- D4i simplifies addition of wireless nodes (network lighting controllers) to luminaires
  - Luminaire can participate in a remote lighting-control network

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

Emerging DALI capabilities:



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:

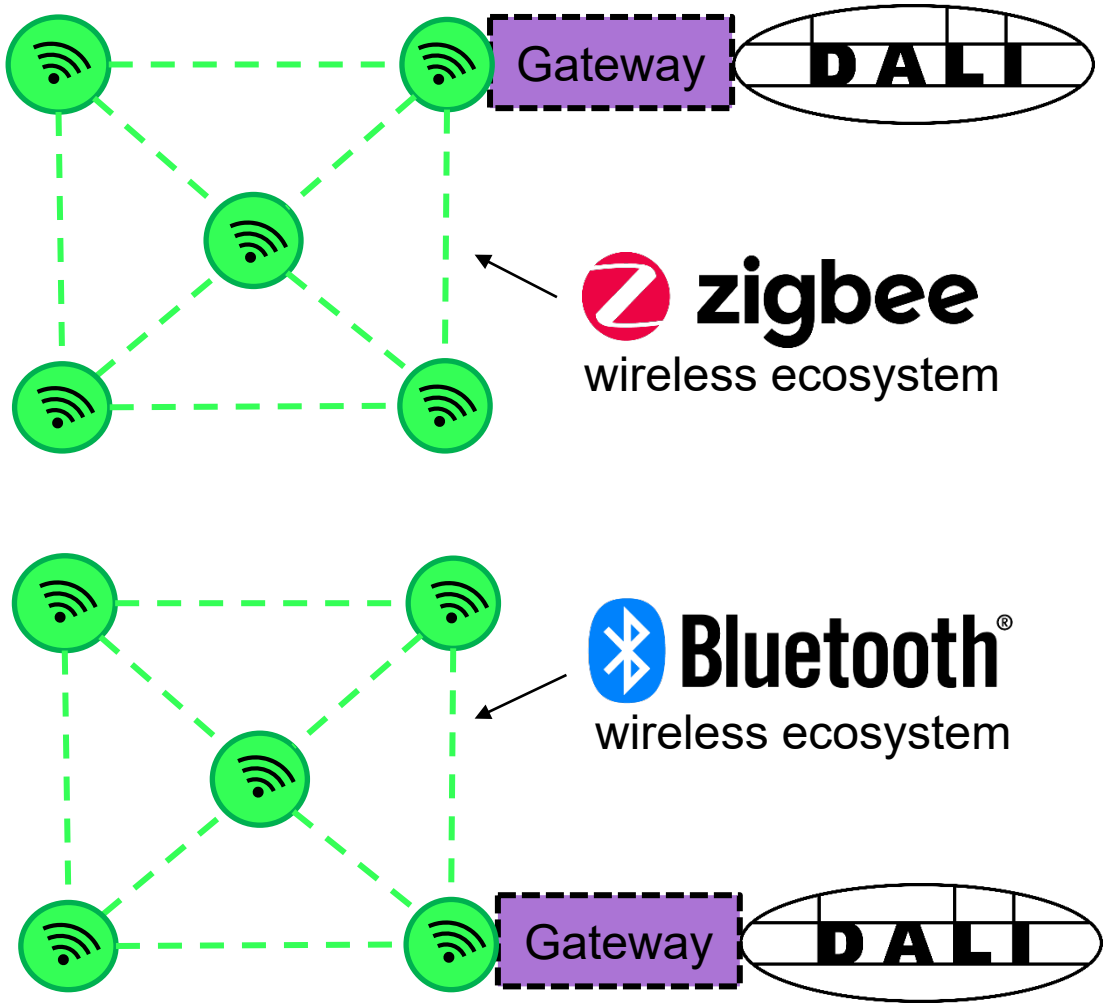
Bluetooth®

csa connectivity standards alliance

THREAD GROUP

Wireless solutions for DALI

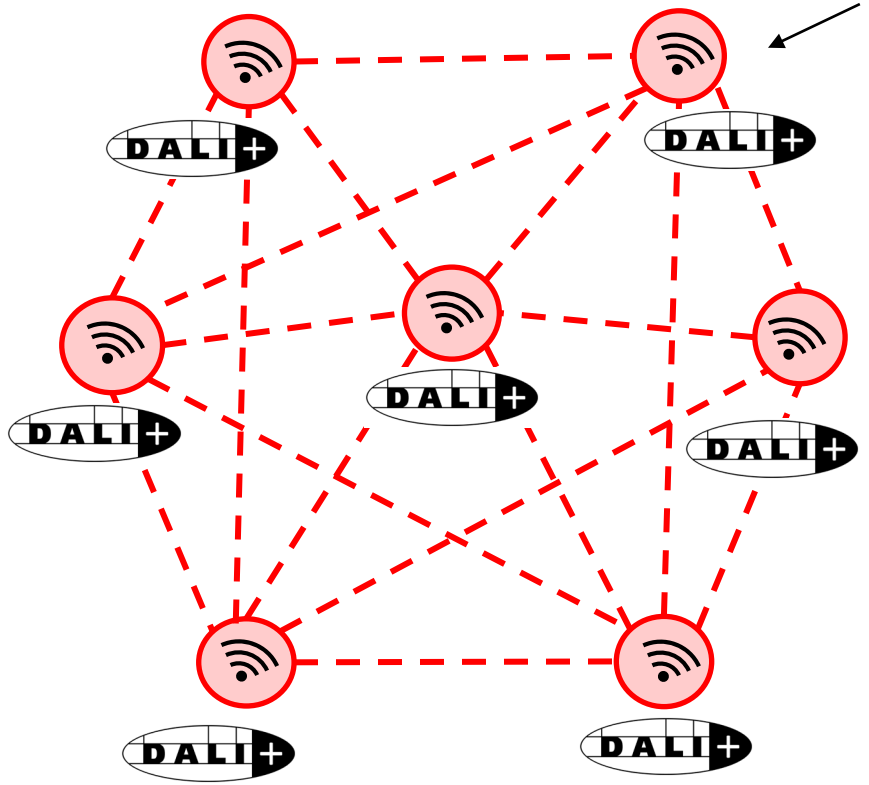
Wireless to DALI Gateways



Wireless DALI

DALI+™

Wireless DALI+ devices in a mesh network



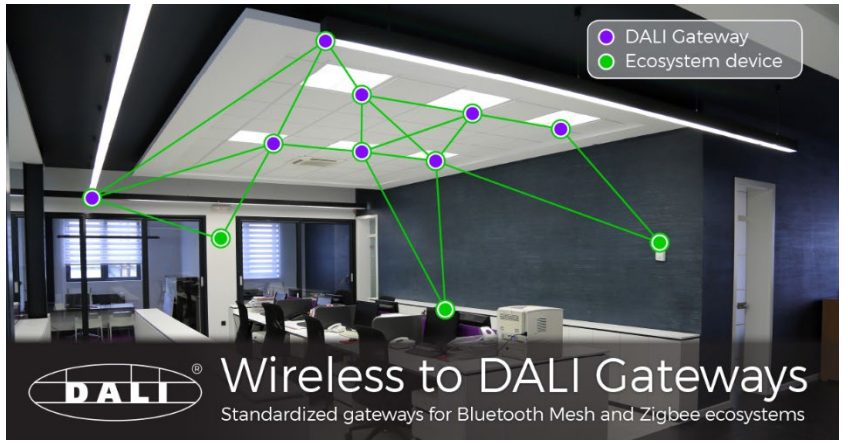
Gateways

Wireless to DALI gateways

- Wireless to DALI Gateways:
  - Allow **existing DALI wired products** to be used in a non-DALI **wireless ecosystem**
  - Translate between DALI and a wireless protocol
  - Connect to the wireless ecosystem and to the DALI system

- Two wireless ecosystems are supported initially:
  - **Bluetooth mesh lighting model**
  - **Zigbee**

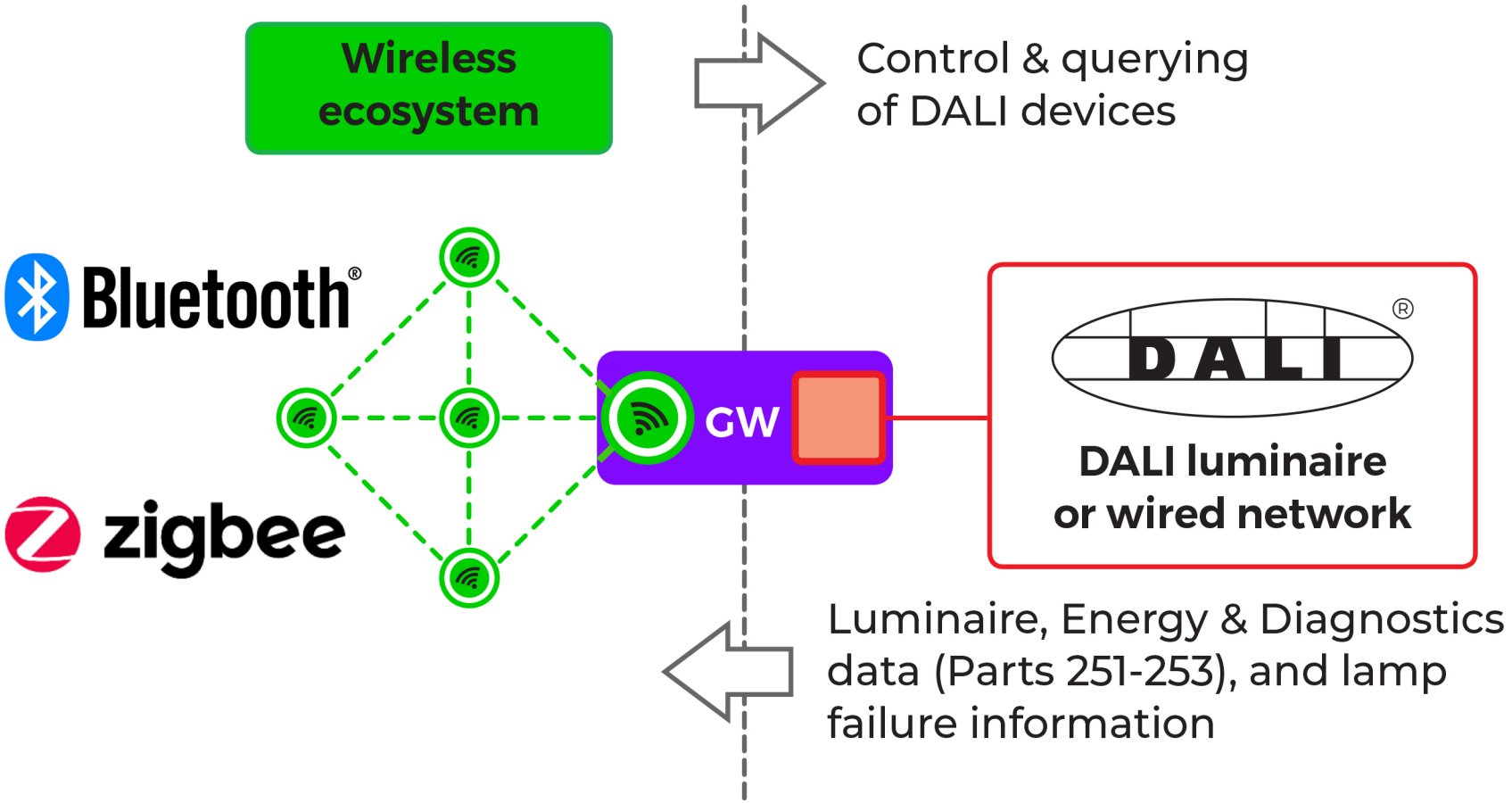
- We have published two new DiiA Specifications:
  - **Part 341: Bluetooth Mesh to DALI Gateway**
  - **Part 342: Zigbee to DALI Gateway**



- Tests are under development, which will enable future certification
- Gateway devices will be added to the DALI-2 (and D4i) certification program

Standardized Wireless to DALI Gateways

Allow use of **existing DALI wired products** in a non-DALI **wireless ecosystem**



Wireless to DALI Gateways – Benefits

- Gateways provide the flexibility to incorporate DALI luminaires and other DALI devices into the wireless ecosystem control network.
  - Easy to add DALI lighting capabilities alongside the other features of the wireless ecosystem
  - Provides flexibility and creative freedom for lighting designers, OEMs, and system integrators

- Existing DALI devices can be used with these gateways.
  - Already an extensive range of certified and interoperable DALI-2 and D4i products on the market

- Gateway specifications ensure well-defined and consistent lighting behaviour.
  - Backed by a joint qualification/certification scheme

- Data and analytics:
  - Wireless network has access to DALI data such as real-time energy and power usage and diagnostics information

Wireless to DALI Gateways – Features

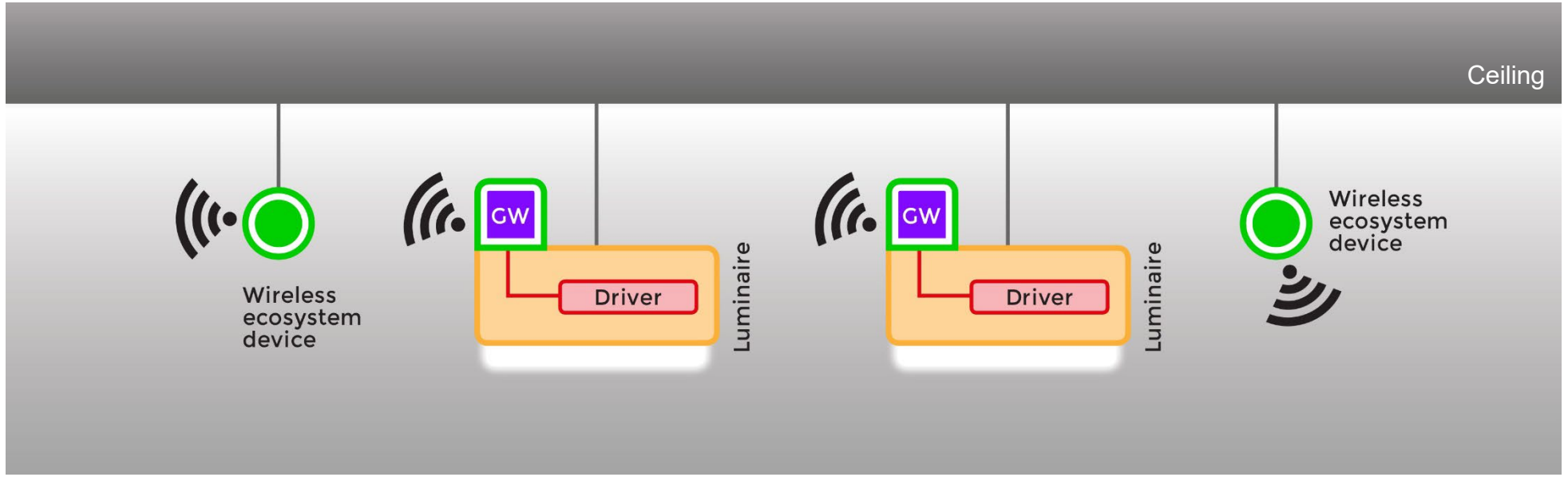
- **Lighting control**
  - GW enables broadcast control of light output from the connected DALI control gear
  - The capability and limits of the ecosystem apply e.g. levels, fade times

- **Data**
  - Gateways provide the ecosystem devices with access to much of the data from:
    - Parts 251 (luminaire data), 252 (energy/power), 253 (diagnostics), and
    - Common control-gear information: control gear missing/failure, lamp failure, light source type
  - Data is aggregated from the connected control gear, and presented to the ecosystem as a single set of data

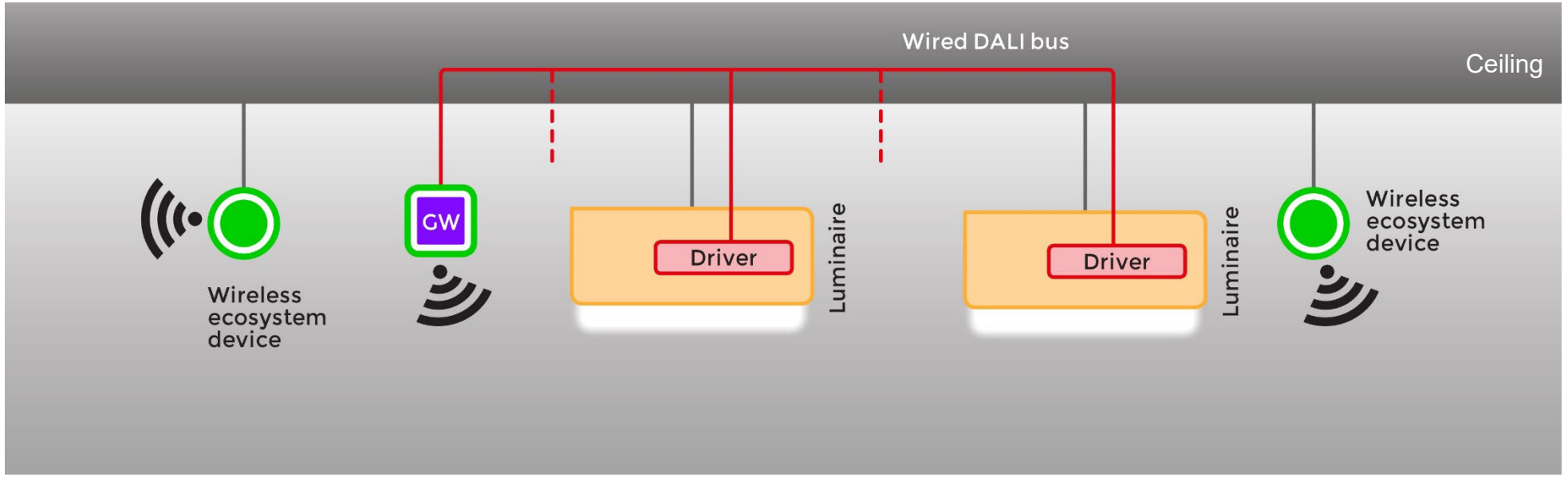
- **Security**
  - Gateways are subject to the requirements of the ecosystem. This means that the security features of the wireless ecosystem apply.

Wireless to DALI Gateways – Configurations

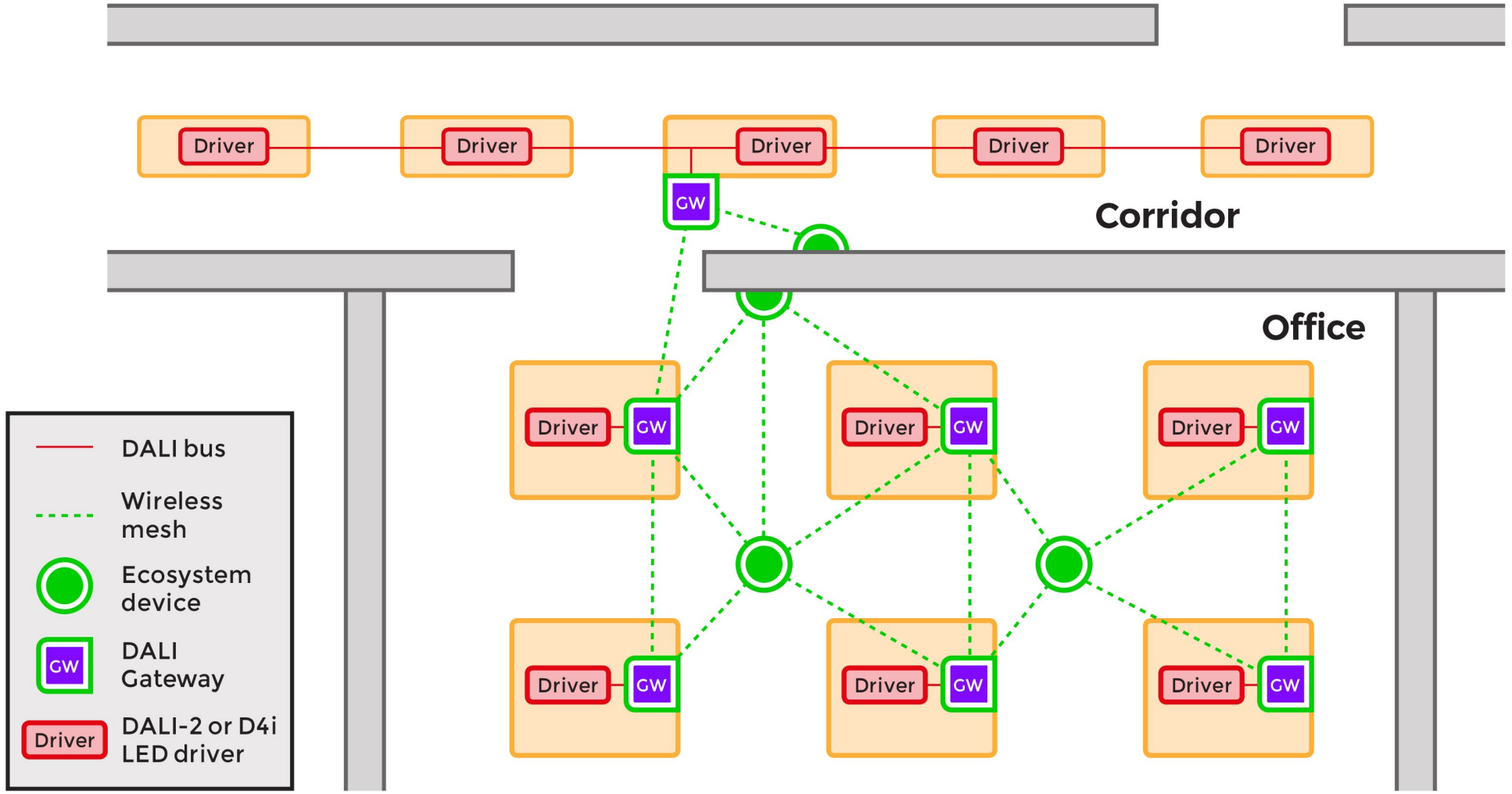
Example 1: Each luminaire has a gateway (GW)



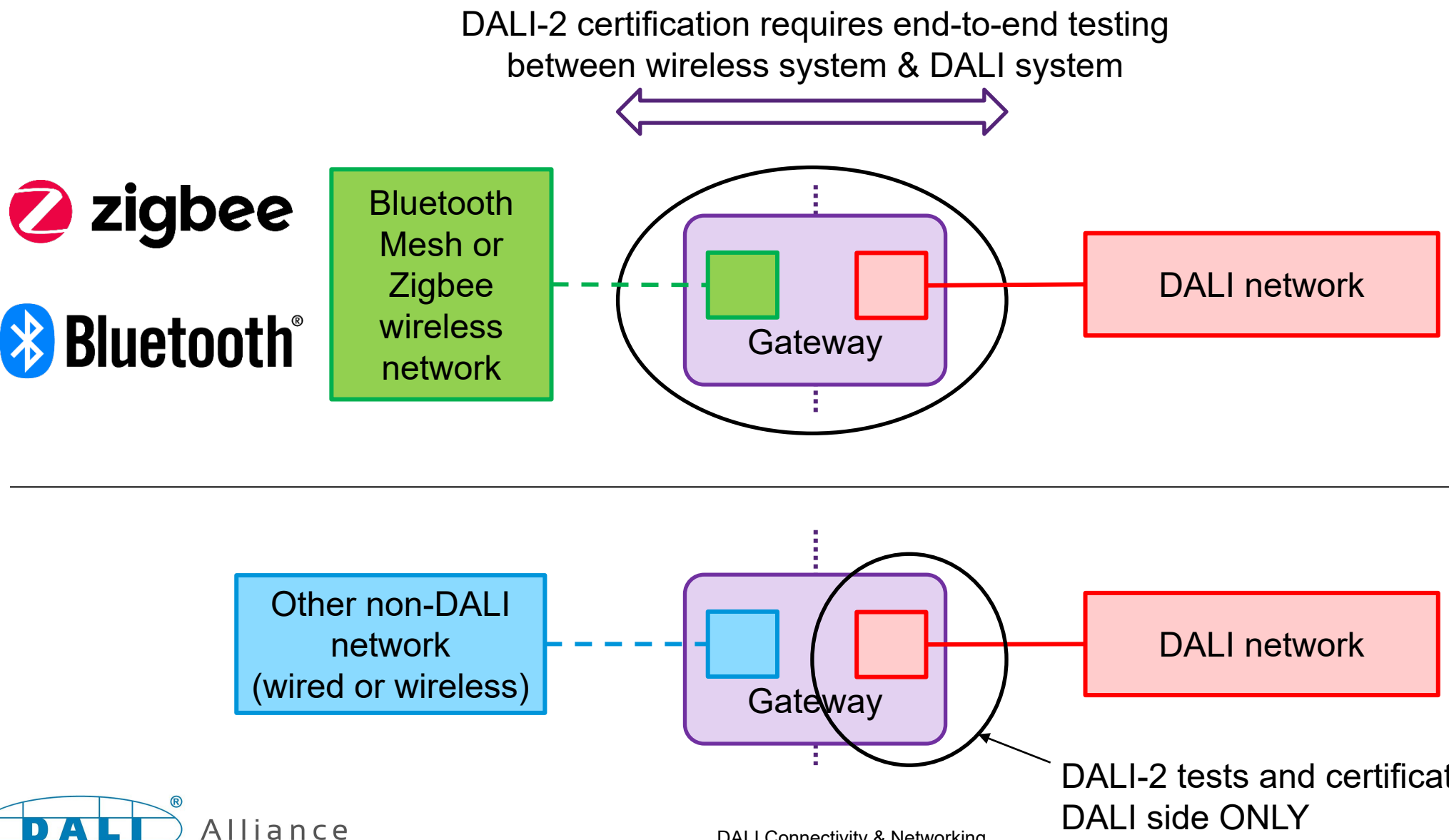
Example 2: One gateway (GW) controls wired DALI subnet



Wireless to DALI Gateways – Implementation

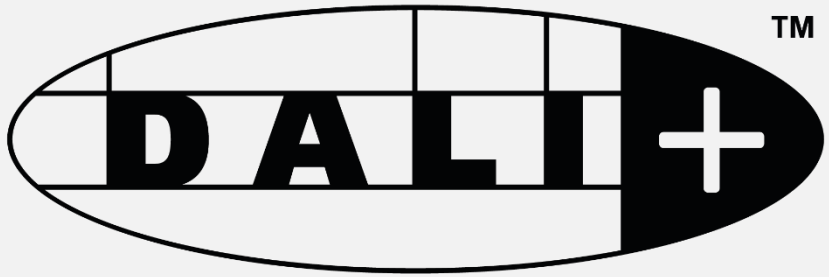


Gateways: Certified and non-certified



DALI+

Introducing DALI+



DALI lighting control
plus
wireless and IP-based networking

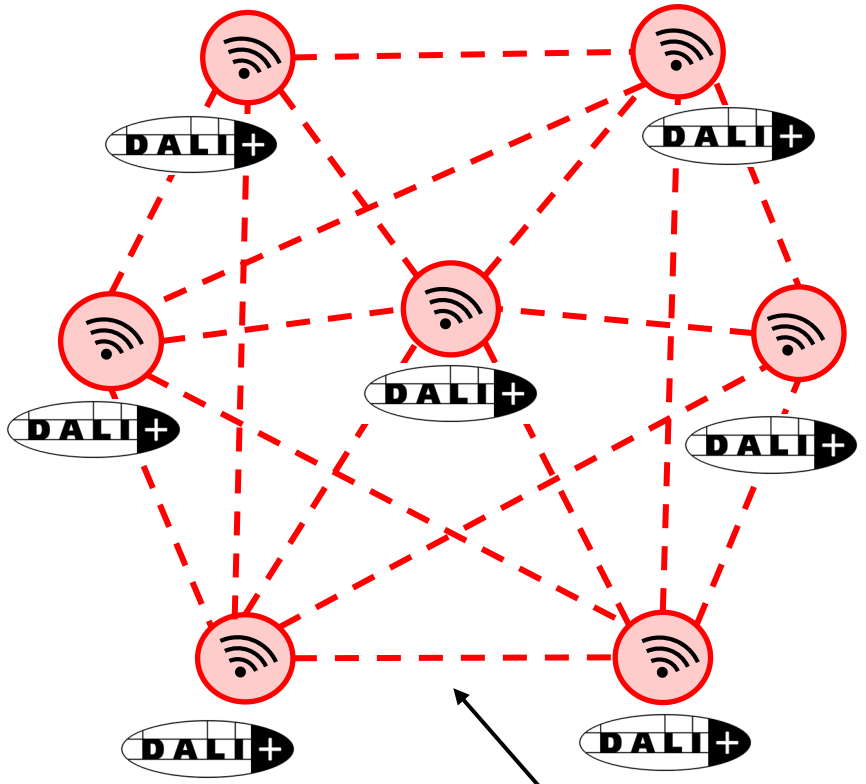
- DALI+ devices communicate using existing DALI commands
- These are carried over a wireless and/or IP-based physical medium
  - Different from the dedicated pair of wires used by DALI-2 and D4i

- 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

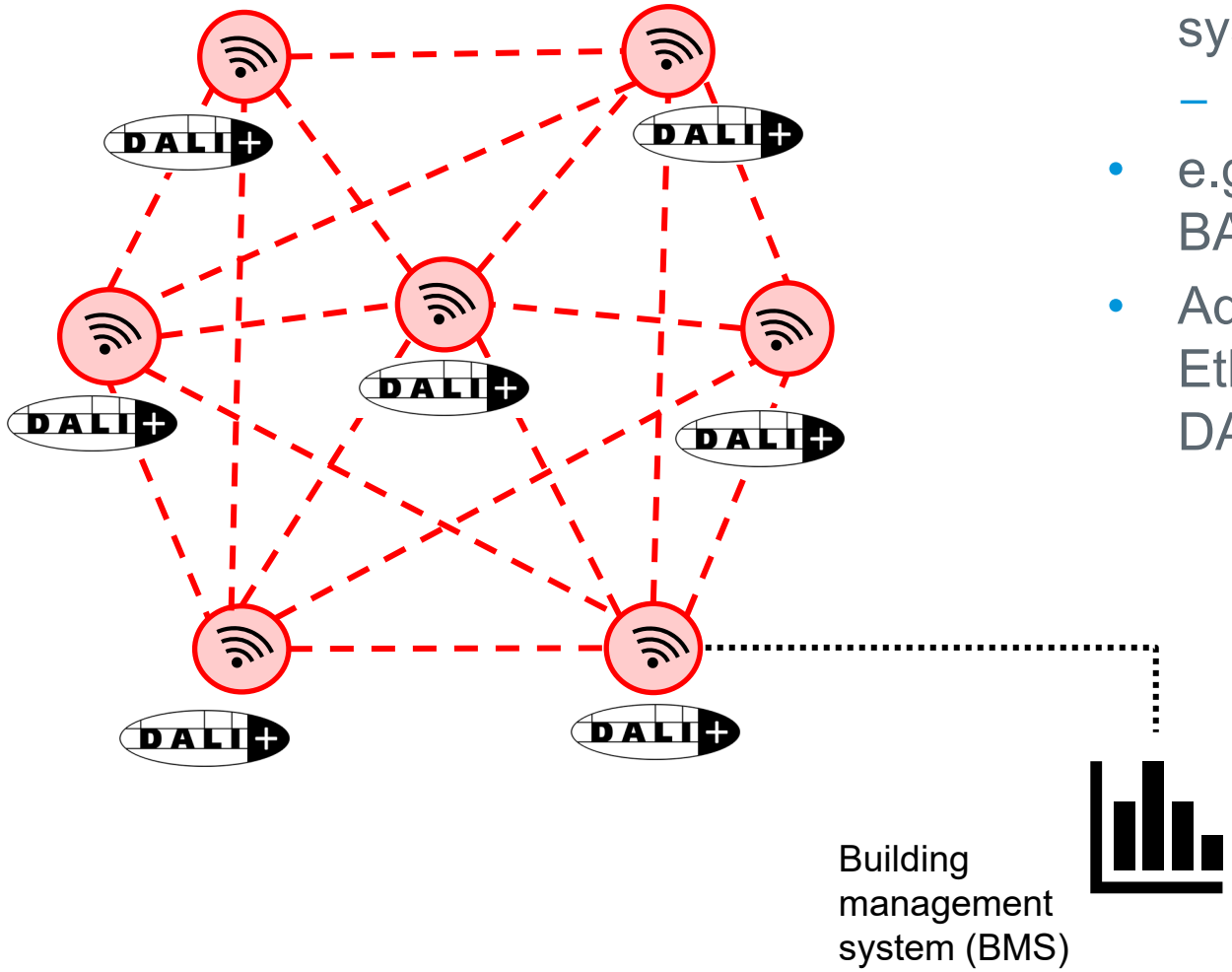

DALI+
DALI lighting control plus wireless and IP-based networking

DALI+ systems



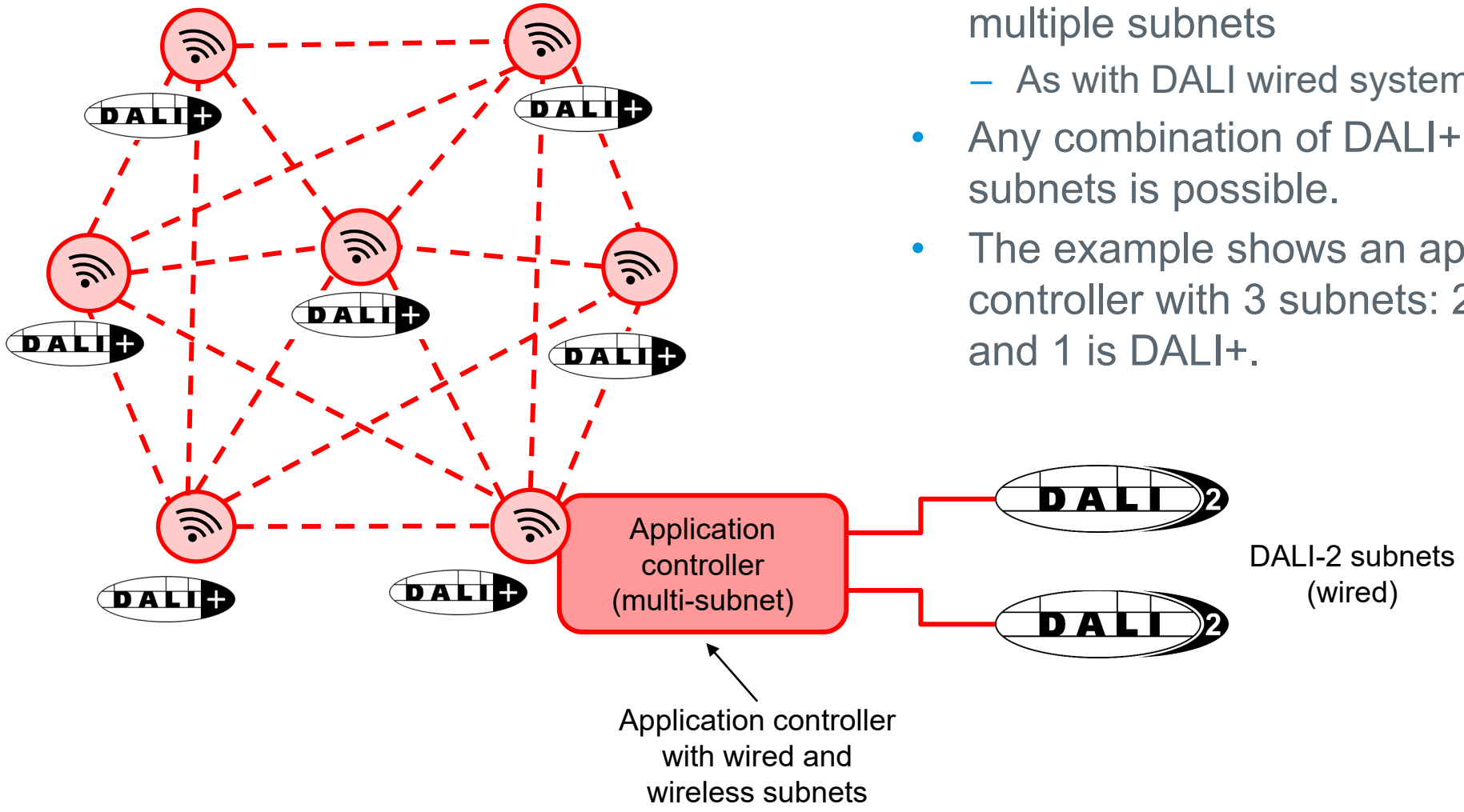
- Entire DALI+ system communicates using the existing DALI language.
- Commands are efficiently packaged into frames, which are transported using a carrier.
- Initial support for Thread as a wireless and IP-based carrier.
- All DALI control gear and control devices from IEC 62386 can be implemented in DALI+.
  - e.g. LED drivers, colour-controllable drivers, emergency drivers, application controllers, buttons, and sensors.

DALI+ connection to other systems



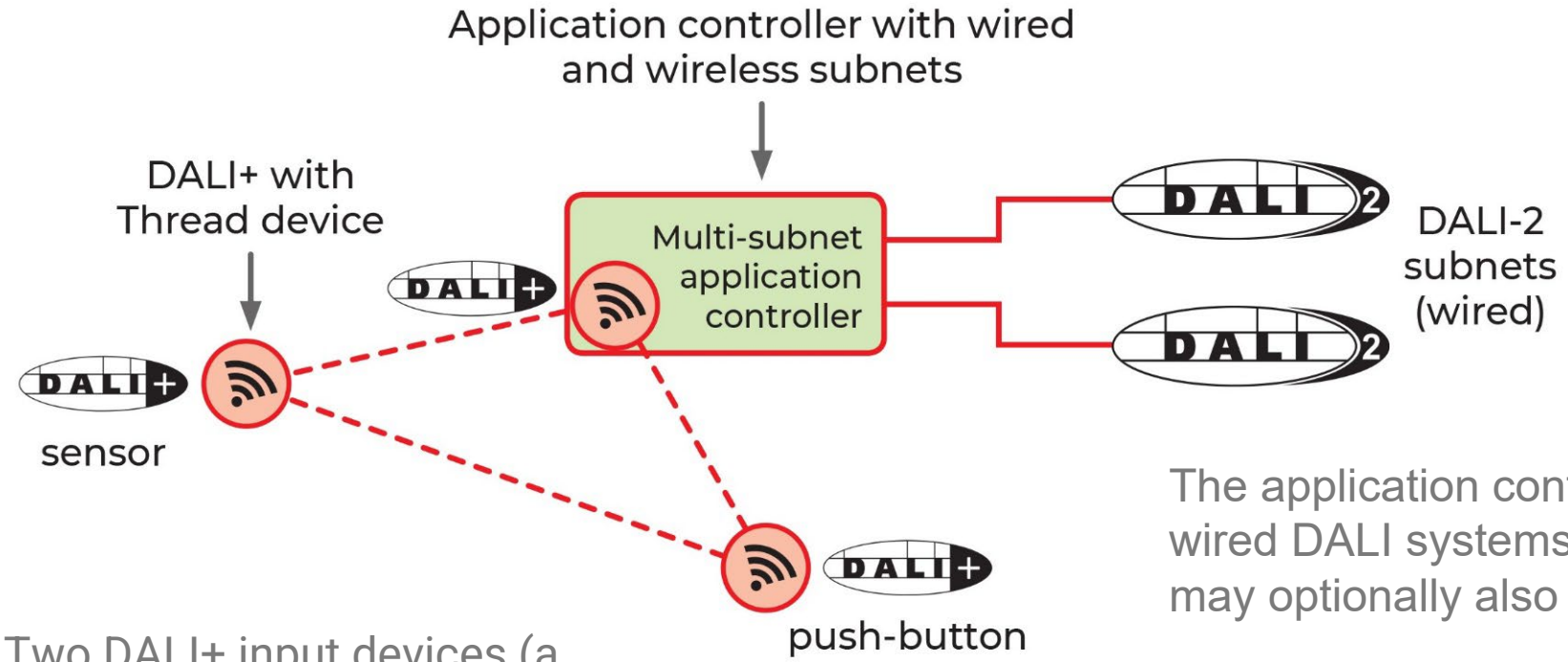
- DALI+ systems may be connected to other systems
  - As with DALI wired systems
- e.g. connection to a BMS through a BACnet interface.
- Additionally, a backbone (e.g. using Ethernet) may be used to connect multiple DALI+ systems together.

DALI+ support for multiple subnets



- DALI+ application controllers may support multiple subnets
  - As with DALI wired systems
- Any combination of DALI+ and wired DALI subnets is possible.
- The example shows an application controller with 3 subnets: 2 are wired DALI and 1 is DALI+.

DALI+ support for multiple subnets – example



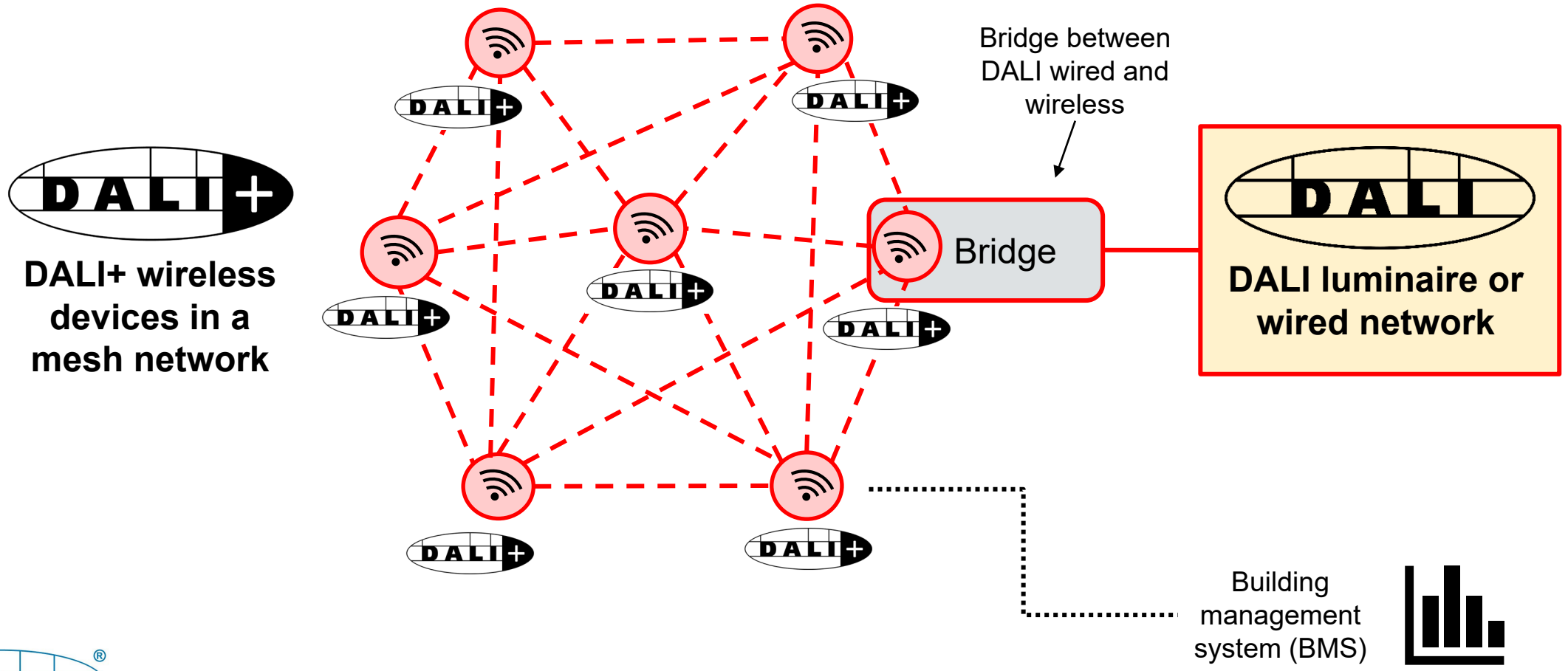
Two DALI+ input devices (a sensor and a push button) are connected wirelessly to a single application controller with a DALI+ interface.

The application controller also has two interfaces for wired DALI systems, which contain luminaires and may optionally also include input devices.

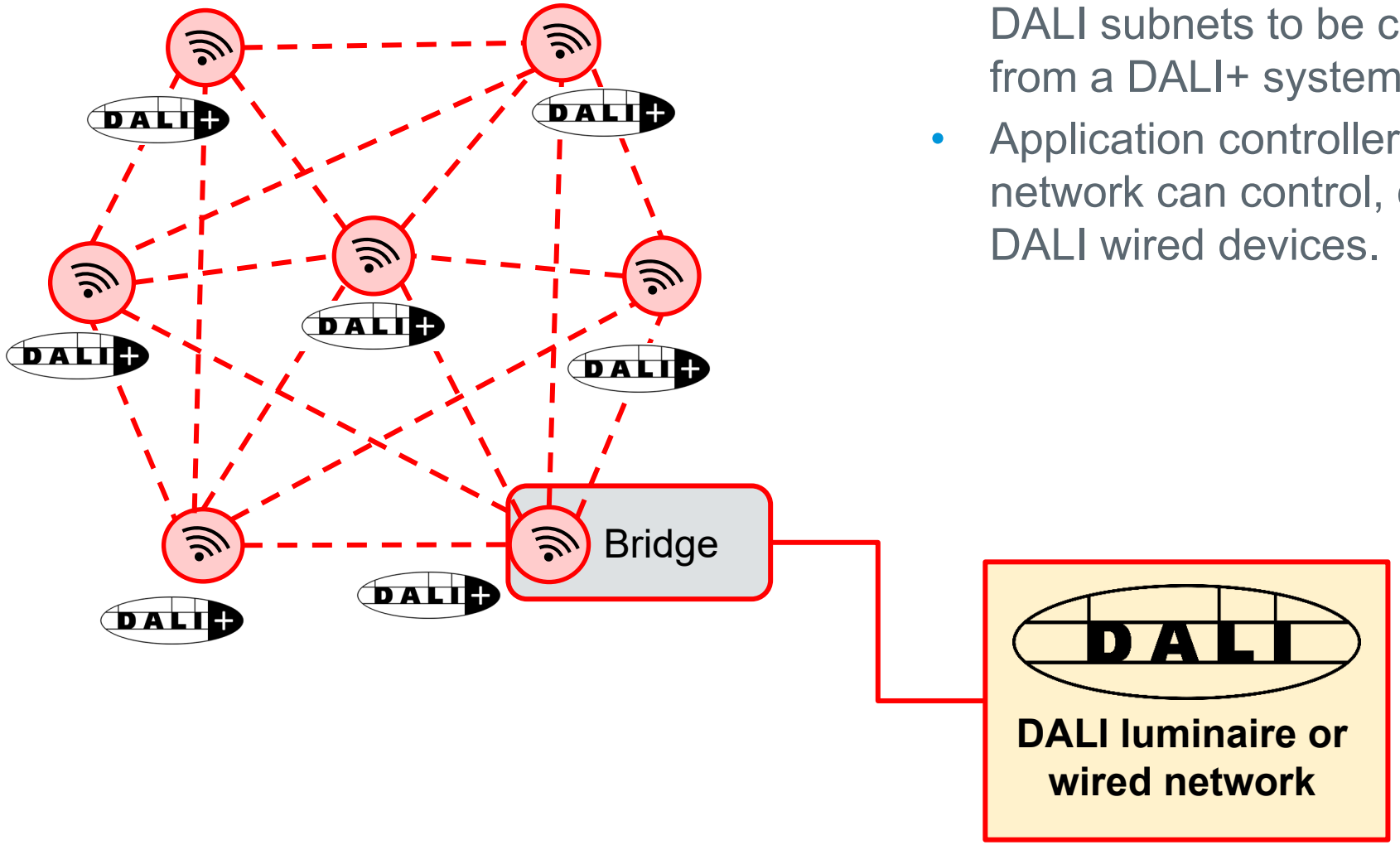
The application controller receives event messages or polls the sensors and push buttons in both the wireless and wired systems.
It then makes decisions and sends commands to the bus units in the wired DALI subnets, controlling the lighting.

DALI+ bridges – Overview

- 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

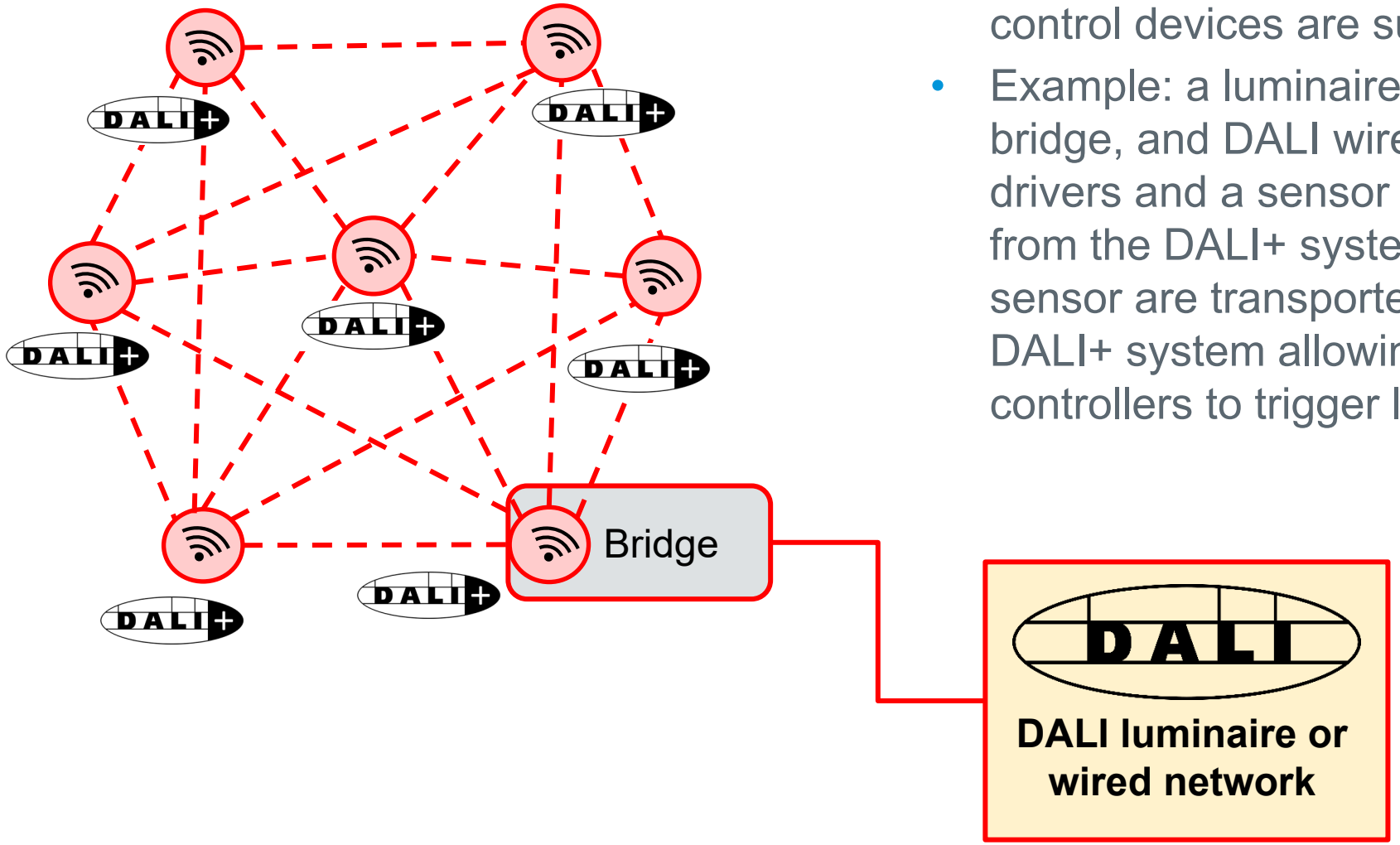


DALI+ bridges



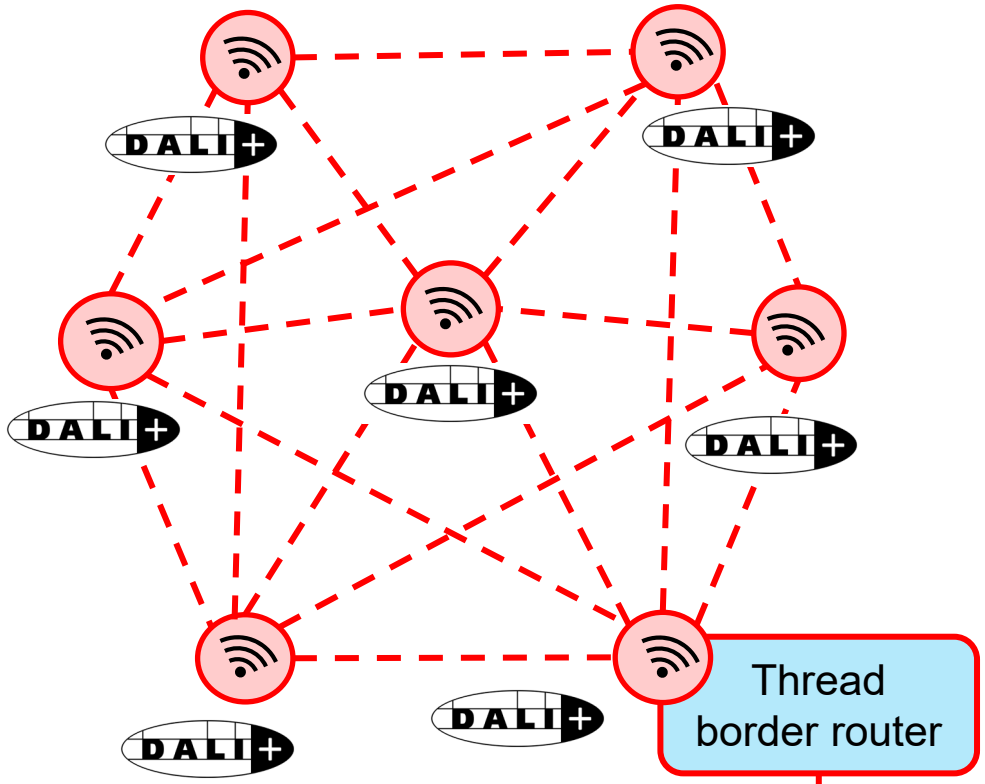
- DALI+ bridges allow one or more wired DALI subnets to be controlled or accessed from a DALI+ system.
- Application controllers in the DALI+ network can control, configure and query DALI wired devices.

DALI+ bridges



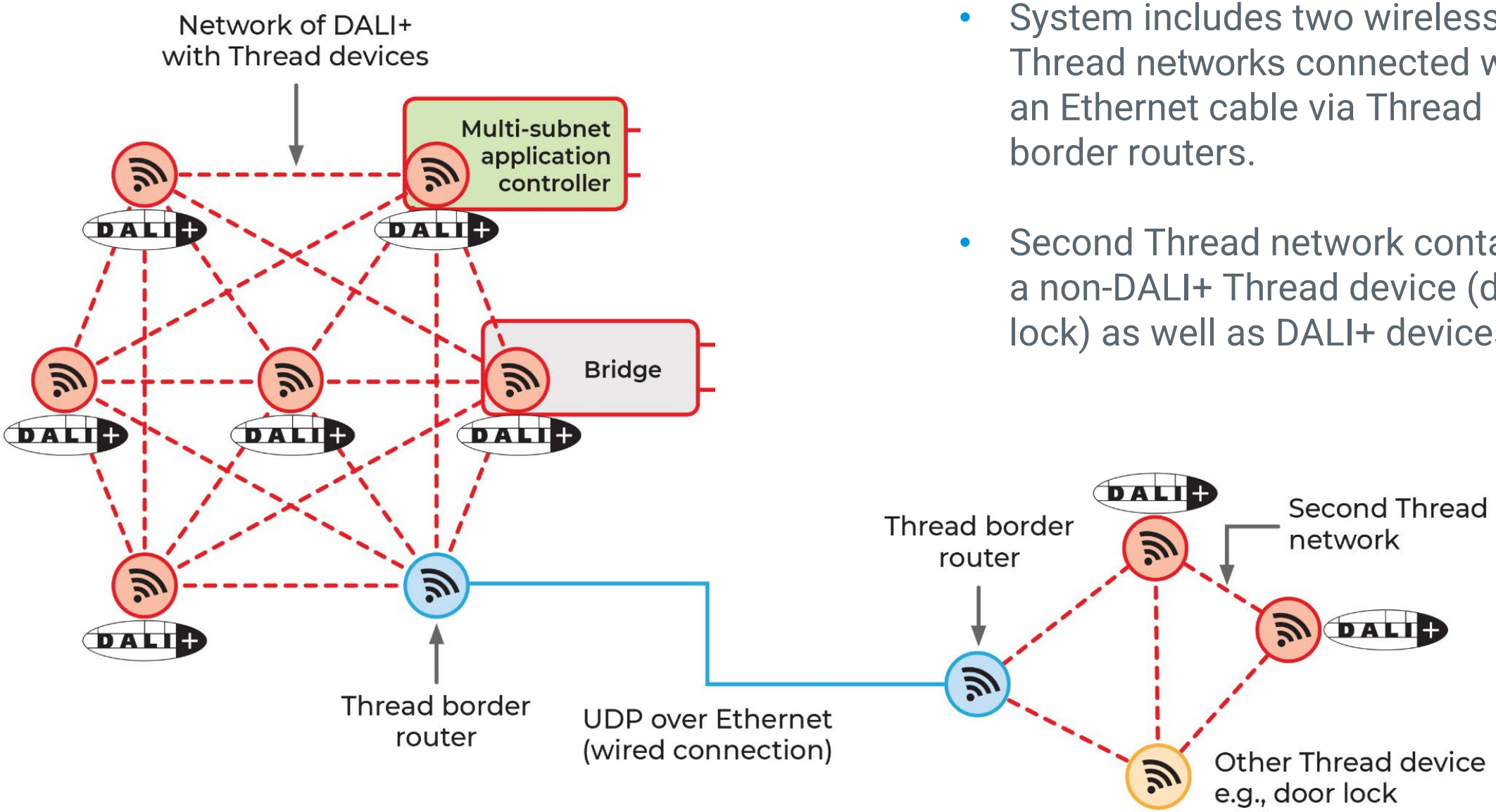
- All types of DALI wired control gear and control devices are supported.
- Example: a luminaire containing a DALI+ bridge, and DALI wired devices – e.g. LED drivers and a sensor – can be controlled from the DALI+ system. Events from the sensor are transported across to the DALI+ system allowing application controllers to trigger lighting changes

DALI+ with Thread



- Thread is the first wireless carrier that will be used for DALI+ devices.
- Thread is a wireless protocol, transporting IPv6 packets using the low-power wireless technology, 6LoWPAN.
- Other Thread devices may be used in the same Thread network as the DALI+ devices.
- Thread **border routers** allow connection through other IP-based physical layers, for example Ethernet or Wi-Fi.
  - Enables highly scalable systems

DALI+ systems connected via Ethernet



- System includes two wireless Thread networks connected with an Ethernet cable via Thread border routers.
- Second Thread network contains a non-DALI+ Thread device (door lock) as well as DALI+ devices.

DALI+ with Thread features

- **How many nodes can be in a DALI+ subnet?**
  - The usual method of DALI addressing allows 64 control gear plus 64 control devices.
  - On top of this, Part 104 of the IEC 62386 standard has a system address, which multiplies the DALI addresses by 255. This provides around 32,000 addresses.
  - DALI+ with Thread allows the use of IP addressing. Thread uses IPv6, and the addressing capability of IPv6 is virtually unlimited for all practical purposes. So, DALI+ systems really have no limit to the size they can be.

- **Security:**
  - Security is provided by the authentication and encryption methods that are already part of Thread
  - CoAPs provide further application-level security and reliability

DALI+ specification details

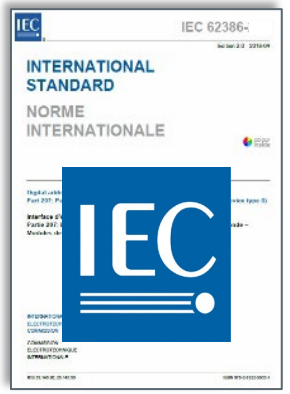
- New DiiA Specification “**Part 104 Changes & Additions**”
- Updates the published Part 104 of the international **IEC 62386** standard

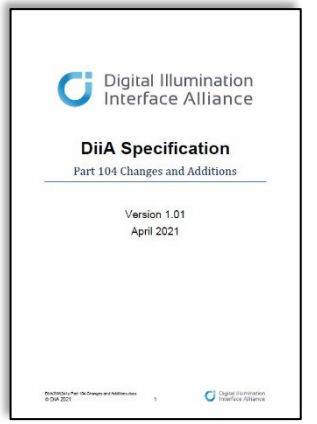
- **Part 104** describes “wireless and alternative wired” systems
  - Describes alternatives to the traditional pair of dedicated wires (DALI bus)
  - DALI commands are carried over other physical media

- Several options for the carrier protocol:
  - **Wireless** options e.g. Thread, WiFi, Bluetooth mesh
  - **Wired** options e.g. Ethernet
  - **Internet Protocol (IP)**-based options e.g. Thread, Ethernet, WiFi

New DiiA Specification:
- Supports **IP-based** carriers
- Supports **bridges**, which connect wired and wireless/IP networks

Available from
IEC Webstore





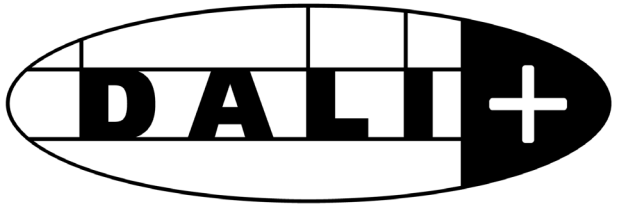
Available from
DiiA website

DALI+ certification

- Separate DALI+ certification programs will be established for different carriers
  - DALI+ devices will be designed to operate over a specific carrier
  - Including familiar device types: control gear, application controllers, sensors & other input devices

- DiiA Specification initially supports IP-based protocols
  - e.g. Thread, Ethernet, Wi-Fi

- Tests are in development to enable a new “**DALI+ with Thread**” certification program
  - In collaboration with Thread Group



with

IP-BLiS

- 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

STANDARDS JOINING FORCES

BACnet International

csa connectivity standards alliance

DALI Alliance

KNX

OPEN CONNECTIVITY FOUNDATION

THREAD GROUP

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

Today: Building technologies in silos

There are more and more connected devices in Smart Buildings every day.

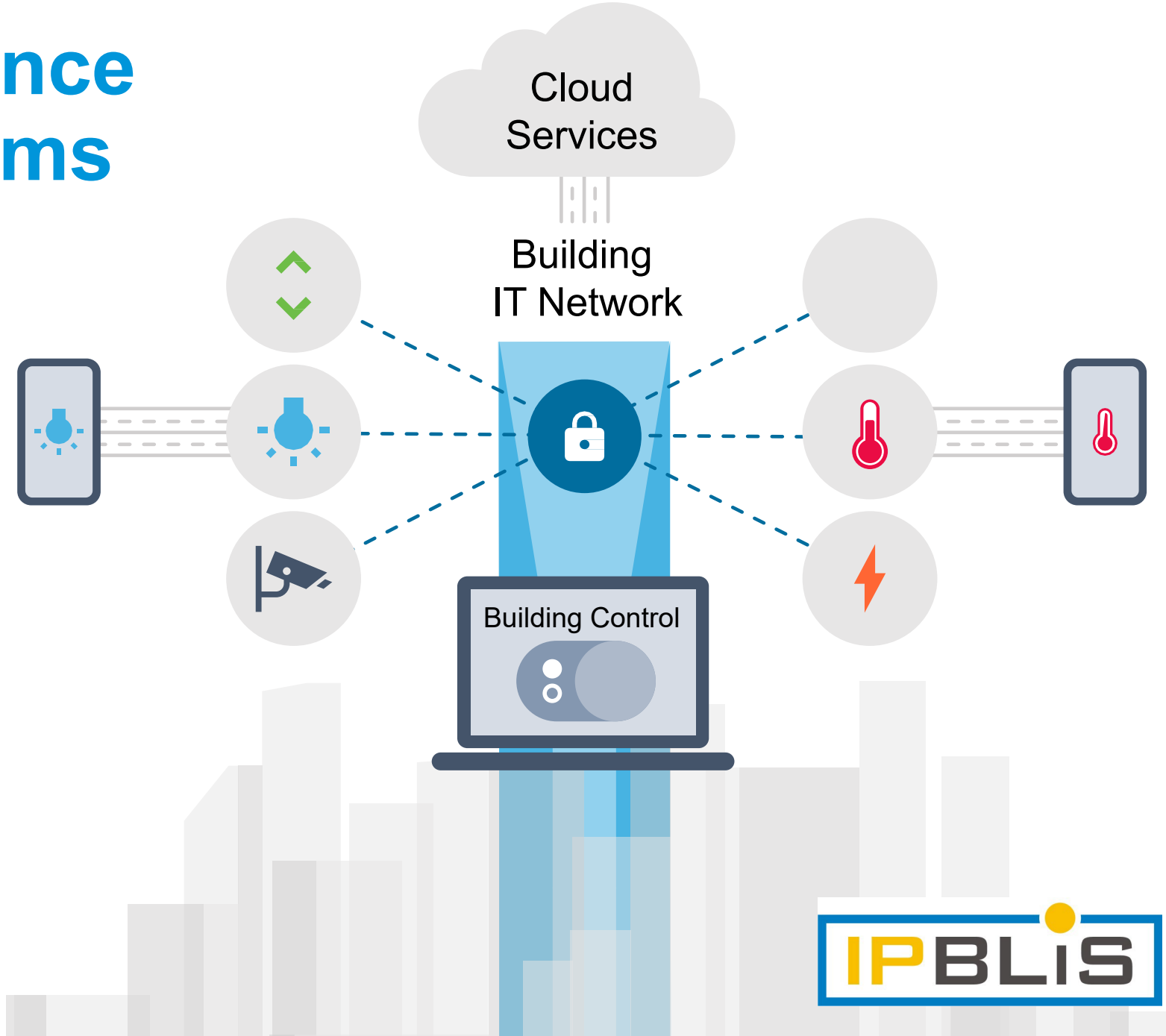
Each system evolved independently with its own proprietary solutions.

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.



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