

The Future of Lighting Is Smart

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The Future of Lighting Is Smart

- What is Smart Lighting and how do we get there?
- Communication methods
 - DALI
 - BLE
- Communication: lighting services
- Communication: new services
- Wrap-up

What Is Smart Lighting and How Do We Get There?

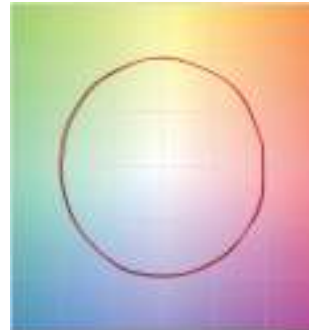
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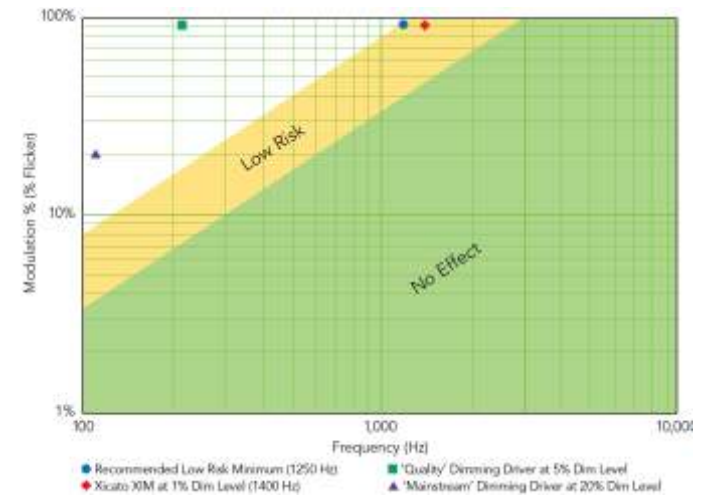
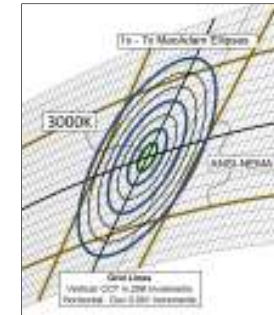
Quality of Light



Color Vector Graphic



Red line: Xicato source
Black line: reference illuminant



What Is a Smart Light and Smart Lighting?

Smart Lights:

- Monitors internal operating conditions and responds autonomously to fault conditions
- Two way communications capability to receive commands and sensor inputs, responding autonomously, and transmit status and event information
- Able to be programmed to modify response to sensor inputs
- Tracking, storing and reporting operating history

Smart Lighting:

- A combination of smart lights and the software program(s) used to set-up and configuring an installation to behave as we want when an event happens

Smart Lighting - How Do We Get There?

- Peer-to-peer two way communications
- Autonomous response

- A clear user interface for set-up, control and monitoring

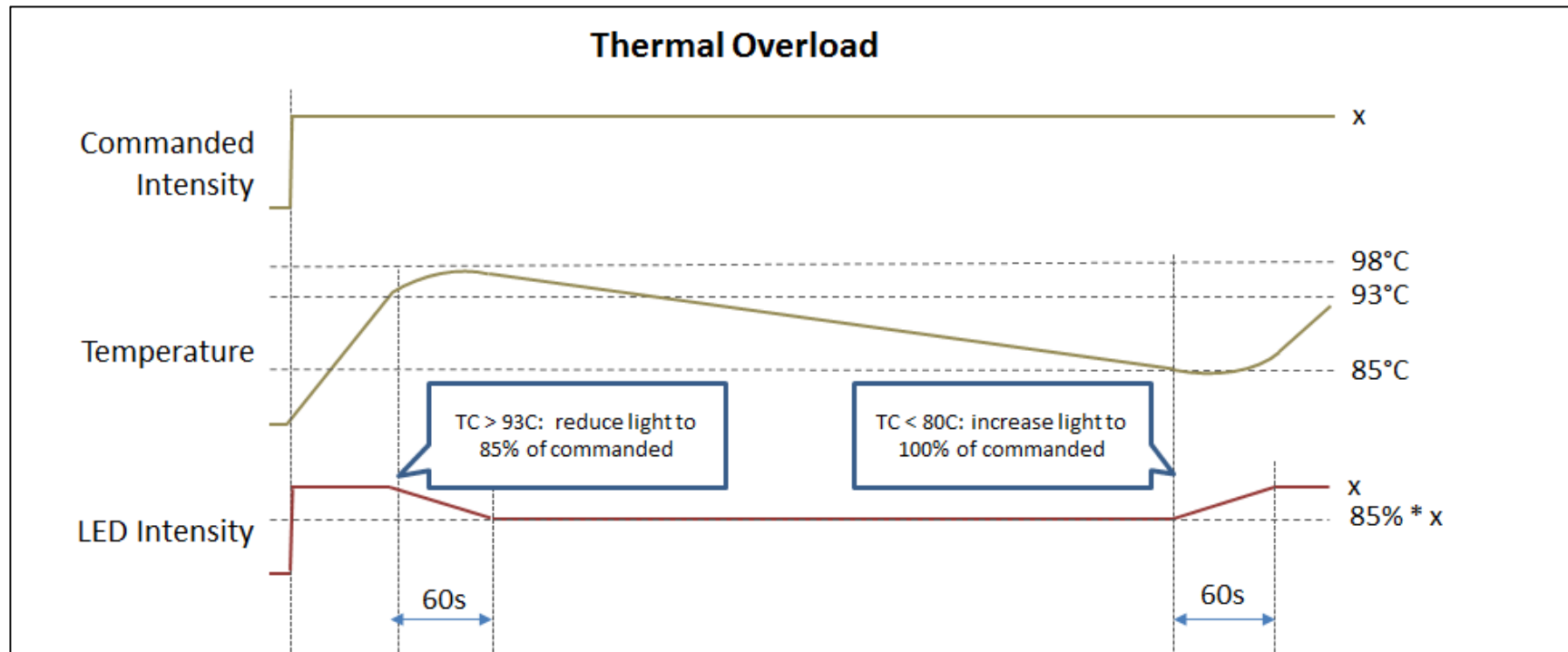
Size, price and capability of localized “intelligence” (microcontroller) and support for communication protocols.

Ease of use and apps



Monitors Internal Conditions and Responds Autonomously to Faults

Thermal Foldback Example

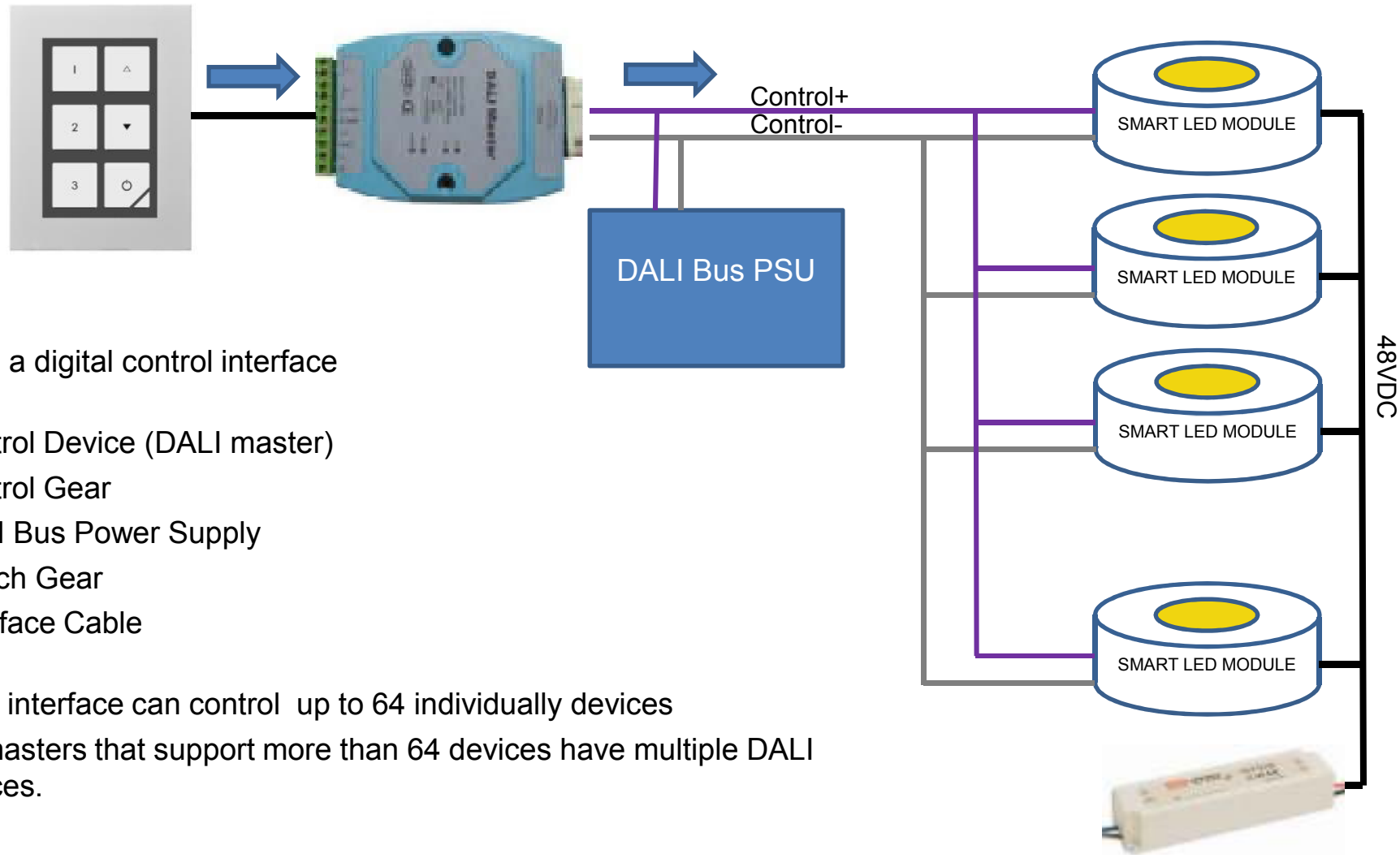


Review and Comparison DALI & BLE

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What is DALI?



DALI is a digital control interface

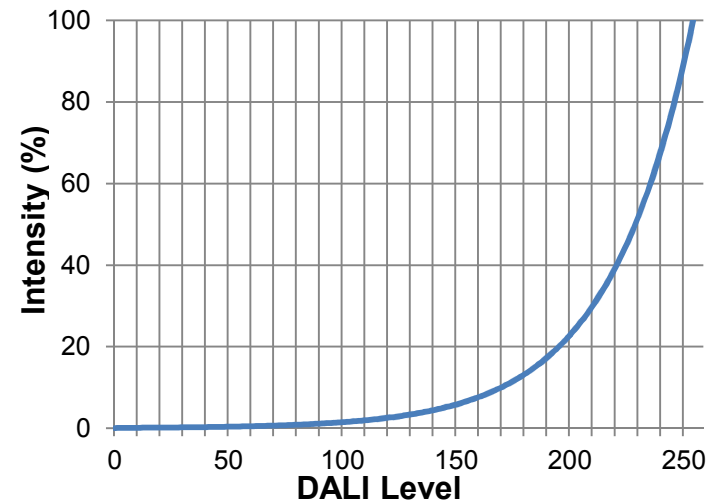
- Control Device (DALI master)
- Control Gear
- DALI Bus Power Supply
- Switch Gear
- Interface Cable

A DALI interface can control up to 64 individually devices

DALI masters that support more than 64 devices have multiple DALI interfaces.

What is DALI?

- System is digital, providing precise control of lights
- Codes state 'where to'
 - Broadcast
 - Group (1-16)
 - Address (1-64)
- And 'information' for:
 - Configuration: fade rates, intensity, scenes and groups
 - Commands: to recall scenes or set levels
- Additional status information can be provided through device (control gear) memory bank accesses like
 - Real time operating temperature
 - Input operating voltage and voltage ripple
 - Operating hours
 - Historical data for temperature, intensity, etc.



Bank	Description
0	Gear Information
1	OEM Information
3	LED Temperature History
4	LED Intensity History
5	LED Vf History
6	DALI Operation Type History
7	Operational History
8	Real-Time Data

DALI – Is It Smart?

- YES, in that 2 way communication is possible
- But limited:
 - No autonomous responses to external events or peer to peer communication. Everything via Master.
 - Latency issue - can be unacceptably slow
 - Difficult to build multi-layered causal relationships between light points
 - No reporting of fault conditions to peers
 - Programming and data collection possibilities limited to DALI standards and what the DALI Master supports
- Provisioning / commissioning for large installations is complex:
 - All processing for every sensor response takes place in a central place
 - Expansion beyond 64 services requires bridging between DALI bus Masters

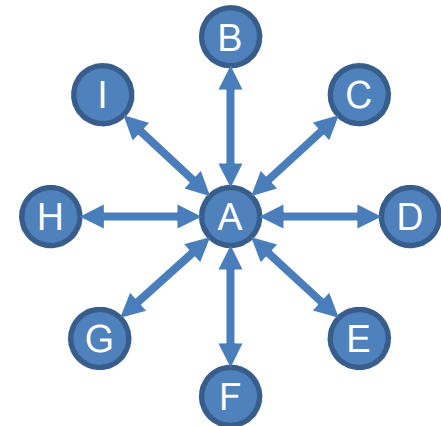
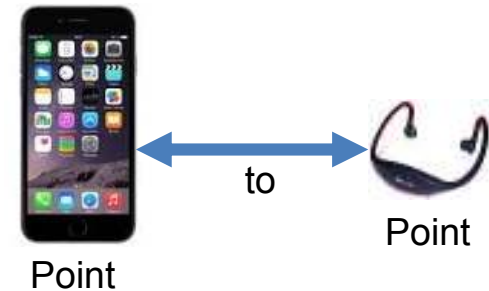
Comparing DALI and BLE

- BLE solves these issues, and:
 - Allows for possibility for indoor positioning services
 - Allows for web or app based developments
 - Advantages of wireless systems ito no 'above the ceiling' expense
 - No 64 device limit on a single interface
- BUT:
 - Requires additional security layers
 - Suitable for local networks: for wider systems gateways needed.

Bluetooth Low Energy – a Brief Introduction

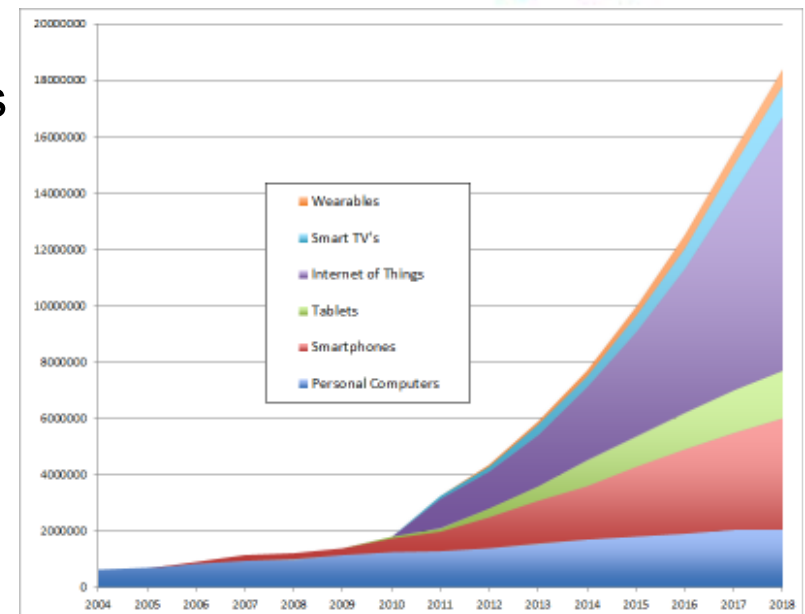
BLE is completely different from traditional Bluetooth

- Traditional Bluetooth
 - Dedicated pairings. Point to point connections.
 - Designed to support data streaming (e.g., voice/audio)
- Bluetooth Low Energy
 - No dedicated pairing – peripherals advertise presence and availability to support connections
 - Star connection topology
 - Small data transfers
 - Device state information (temperature, device ID, light level, turn on, turn off, etc.)
 - Not for large data transactions – e.g., file transfers, streaming, etc.



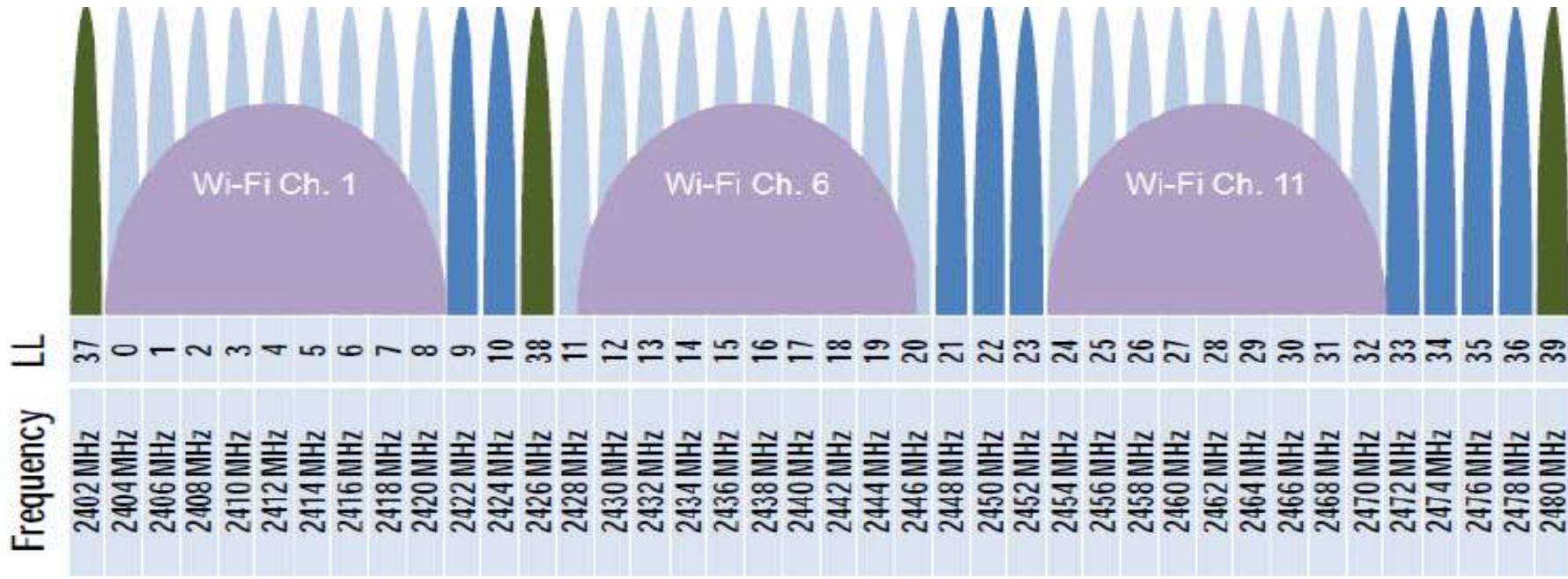
Why Bluetooth LE?

- Ubiquitous support on Smartphones/Tablets
 - Natively supported by iOS, Android, Windows 8, OSX, Linux and Blackberry
- Technology underlying iBeacon, Physical Web, Eddystone
- Strong momentum driven by IoT
- Easy to integrate into embedded devices
- Open Standard
 - Free to join SIG
 - Standards available for no charge
 - No licenses, etc.

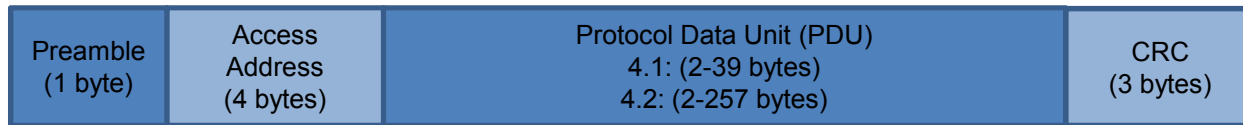
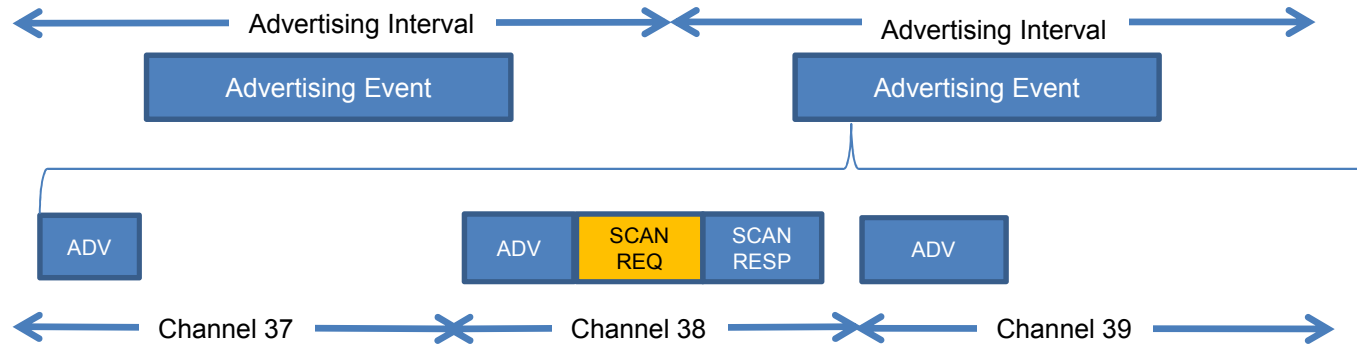


BLE – Radio Overview

- Operates in 2.4GHz ISM band (same as WiFi, traditional Bluetooth and ZigBee)
- 40 Channels on 2MHz spacing
 - 3 dedicated Advertising Channels (37, 38 and 39)
 - Frequencies chosen to have minimum interference from primarily used WiFi channels
 - Used for broadcast advertising and scan request/response
 - 37 Data Channels
 - Used for 1:1 connections between devices



BLE Operating Principle



0	
1	AD Flags
2	
3	Field Length <0x1B>
4	Field Header <0xFF>
5	Xicato Company ID
6	0x0253
7	Device/Package Type
8	
9	
10	Device ID
11	
12	
13	Sequence ID
14	RFU
15	Module Intensity
16	
17	Module Status
18	Module Power
19	Status/Power Extension
20	LED Temperature
21	PCB Temperature
22	Input Voltage
23	Input Voltage Ripple
24	Voltage Extension
25	
26	
27	RFU
28	
29	
30	Data Protection

BLE – Is It Smart?

- Data collection can be done by devices distributed throughout the space
 - No central device
 - Data collection directly from the lights
- Sensors can be easily mapped directly to lights in the space.
 - Sensor events can be handled directly by the light autonomously.
 - The “control system” becomes a light configuration tool that is used to establish rules for the lights to follow based on bonded sensors
 - The system can be web or app based
- Lights can directly communicate with each other as well as sensors
- Programming / Data collection and monitoring are not limited to DALI command response – more feature support options

Communication: Lighting Services

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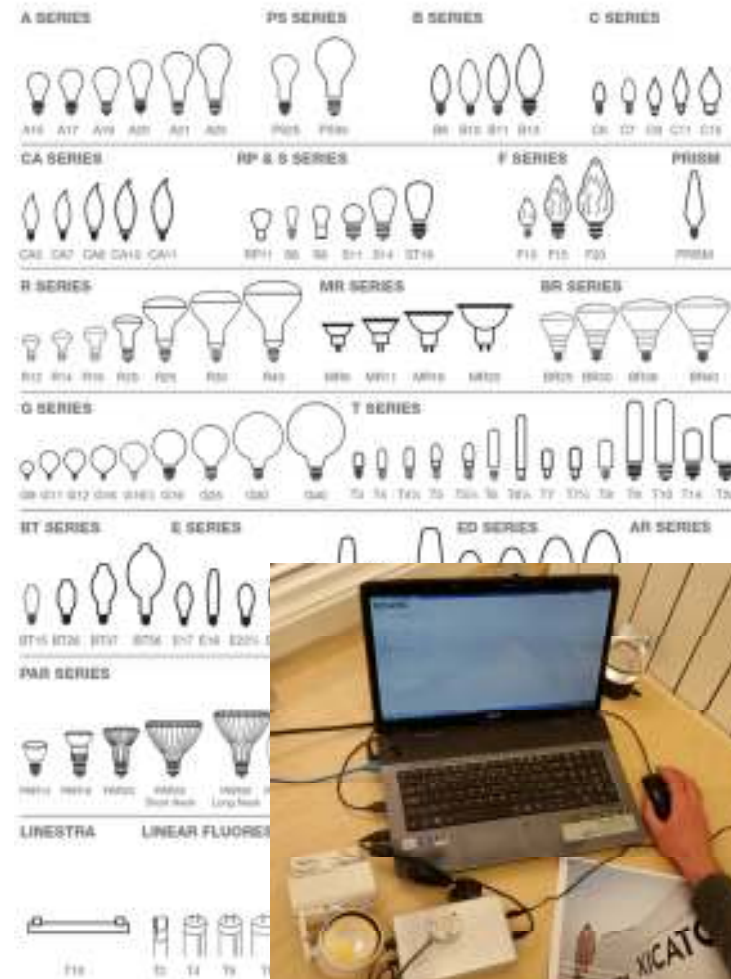


Applications: OEM Configuration

Context: For OEMs to deal with the huge variation of lamps has always been an ordeal.

Configurable smart modules?

- **Max flux, min flux**
- **Fade-rate**
- **Dimming curve**
- **End of life behavior** (when, how manifested)
- **OEM / fixture information**
- Security in operation (eg thermal capability of luminaire cannot be exceeded)



Applications: Commissioning and Usage

Context: low adoption of lighting controls to date but at the same time as tighter energy conservation requirements

- Detect or set **location** address
- Define **groups** and scenes
- **Binding** to switches and sensors
- **Localisation** programming (e.g. avoiding cocoons)
- Set **security access** levels
- **Configure network** connection (DALI, Wi-Fi, Zigbee etc.)

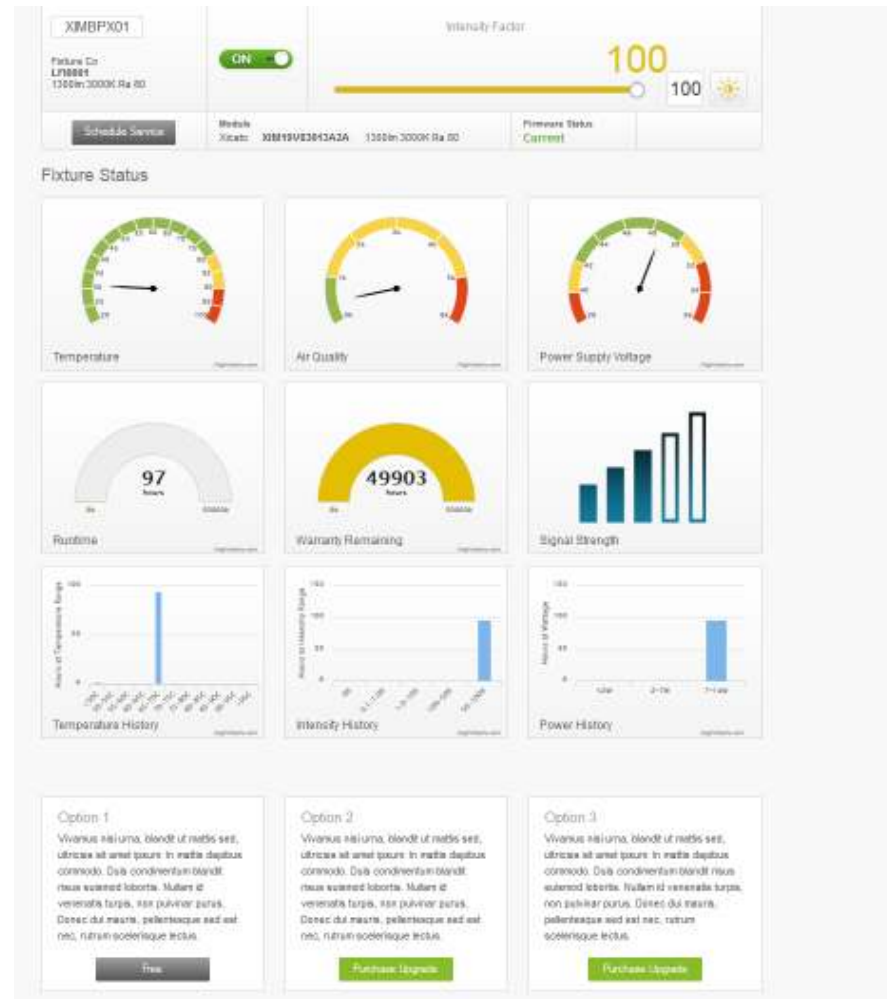


Applications: Maintenance and Diagnostics

Context: maintenance is expensive, especially where image is concerned, eg retail. Constant surveillance, stock keeping of spares, keeping track on warranties

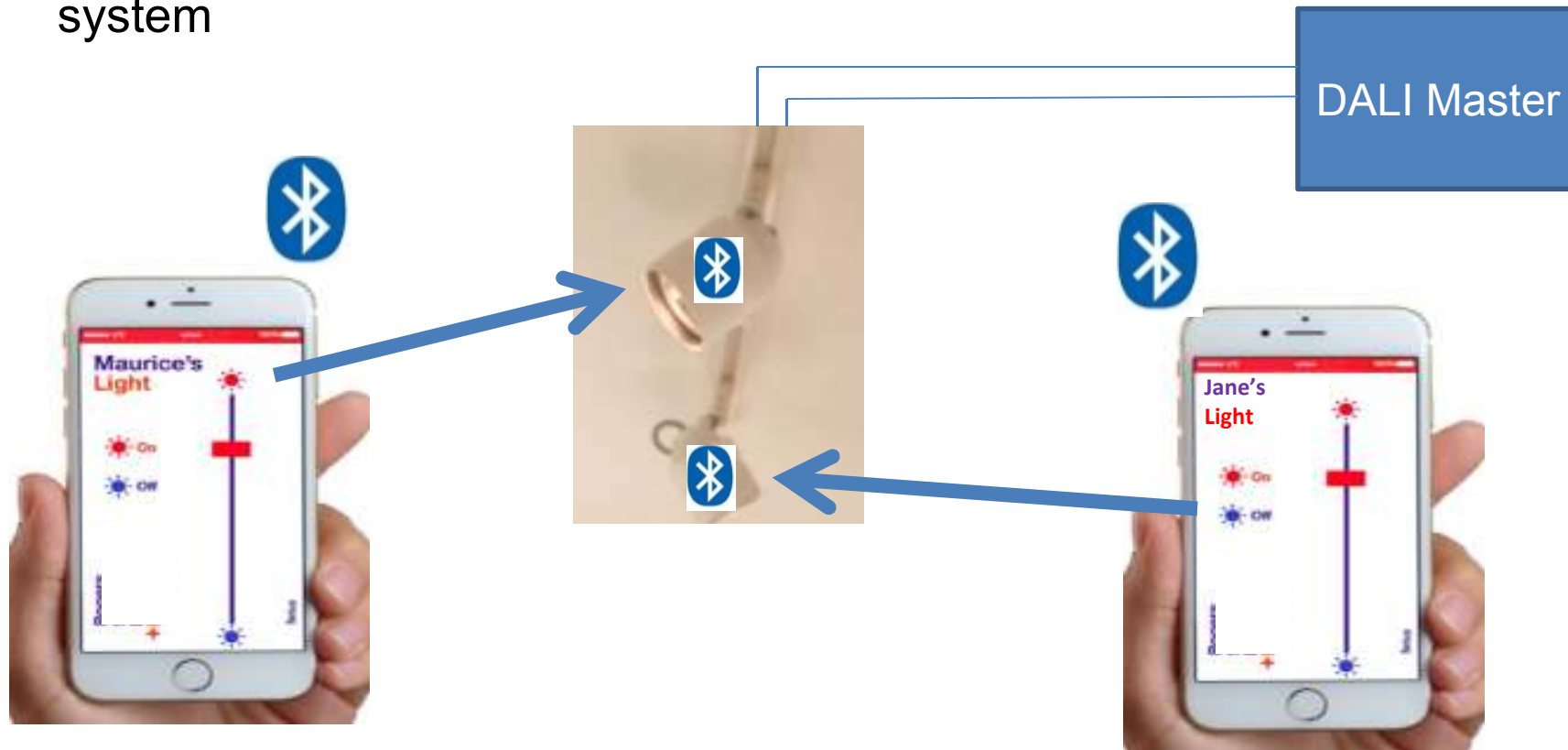
With smart diagnostics:

- Instantaneous information on running status
- Historical data
- Warranty options
- BIM

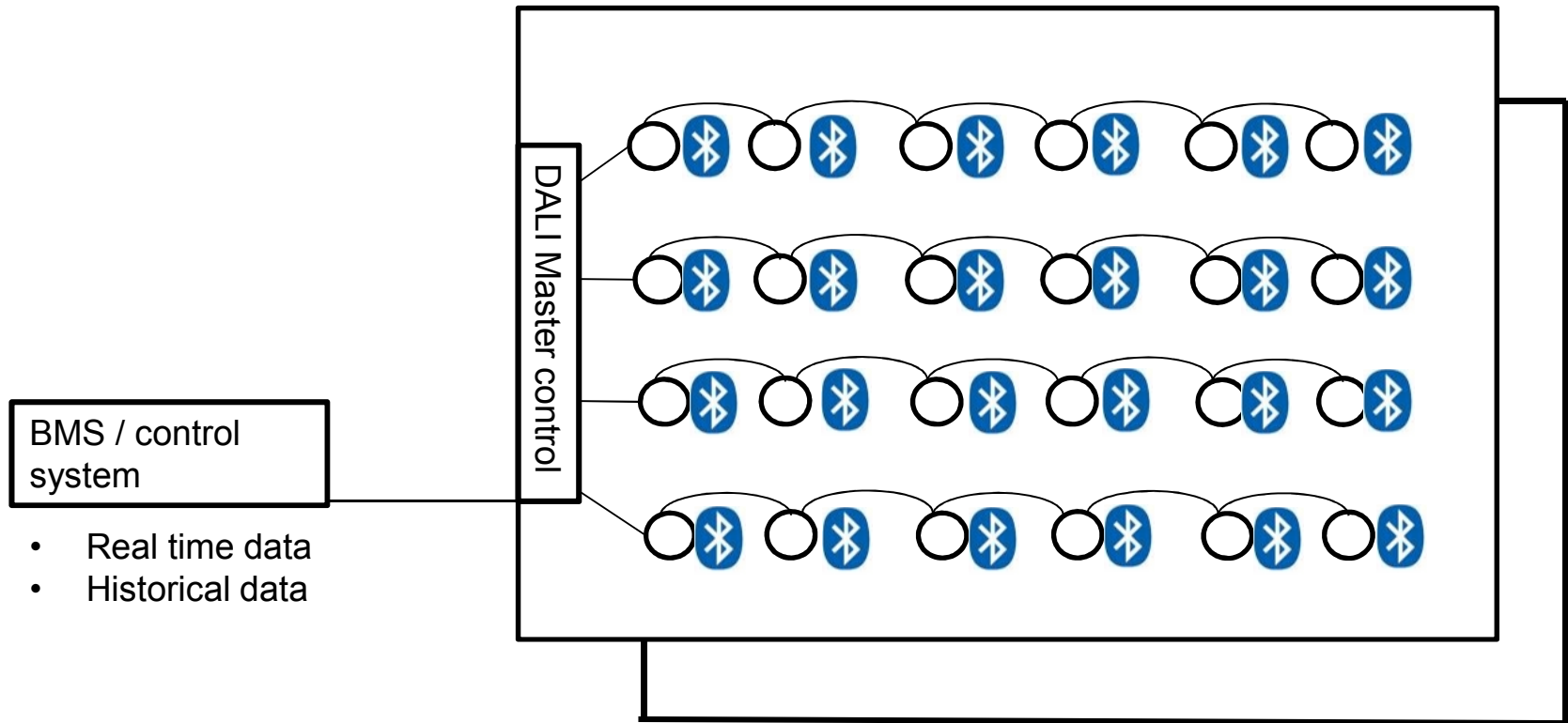


Overlaying Systems

- Provide individual light control to occupants
- Individual override can work seamlessly with a centralized lighting control system such as DALI or a centralized BLE based control system

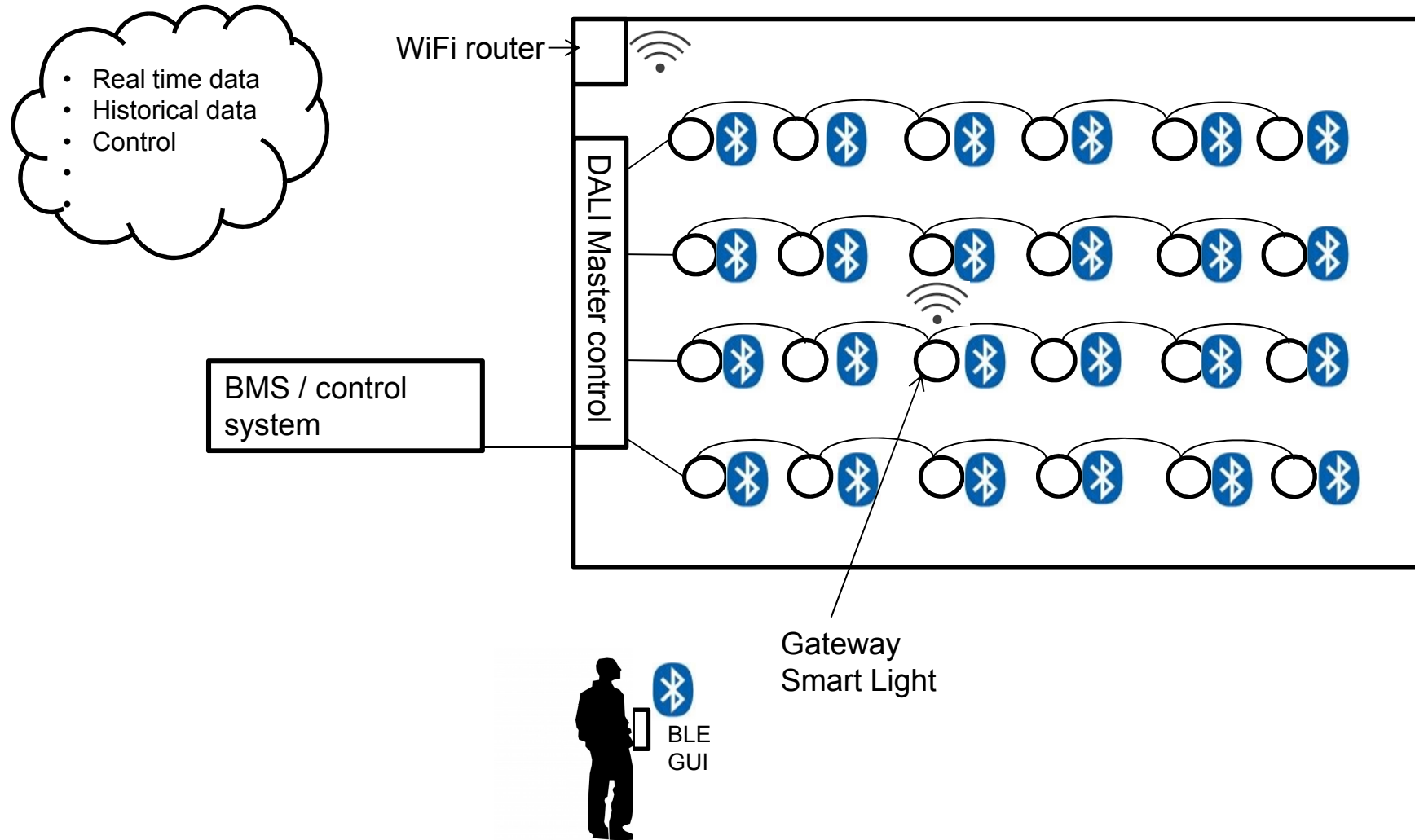


Applications: Overlaying Systems

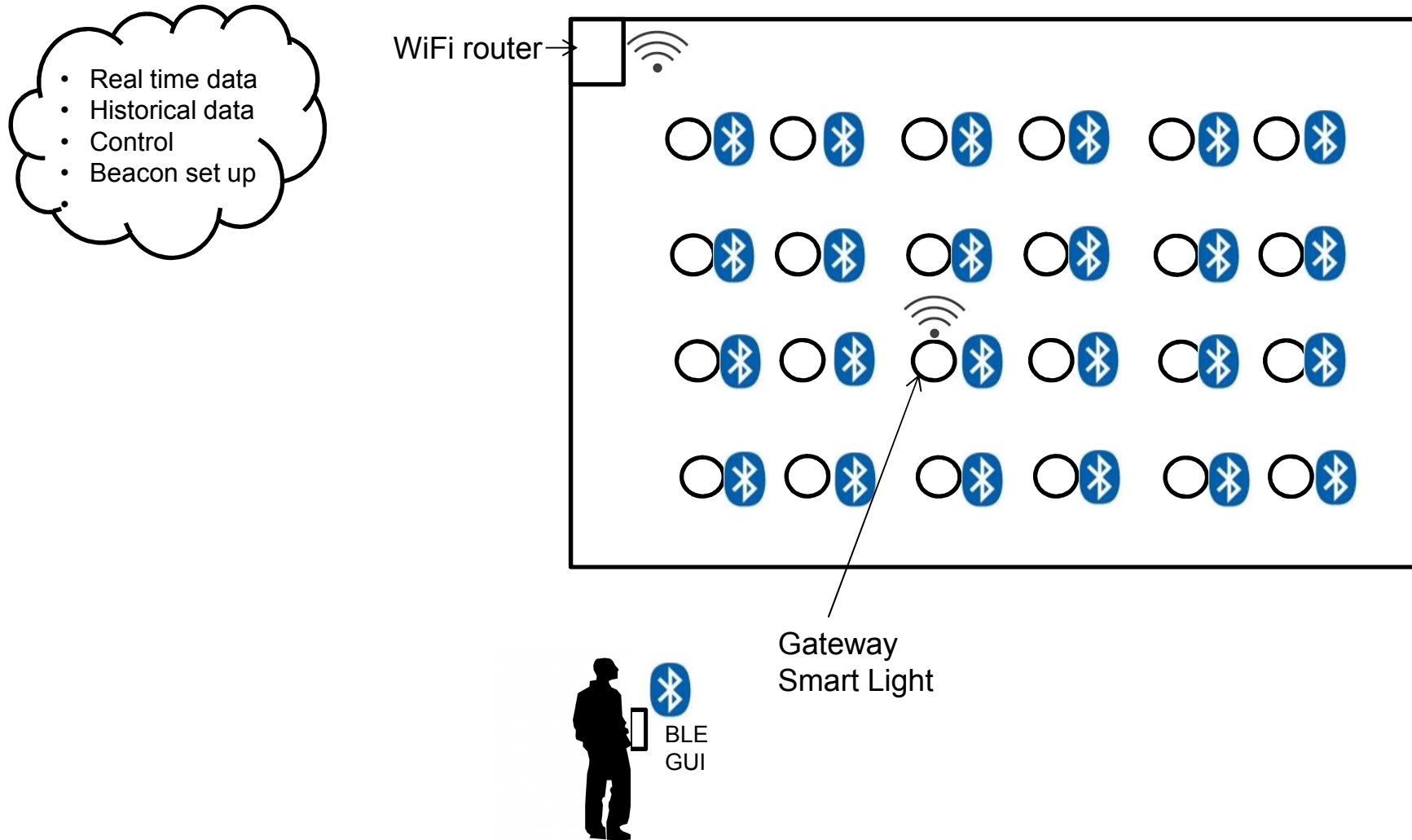


- Localised control
- Real time data
- Historical data
- Beacon technology
- Push firmware updates

Applications: Overlaying Systems



Applications: Cloud Based System



Communication: New Services

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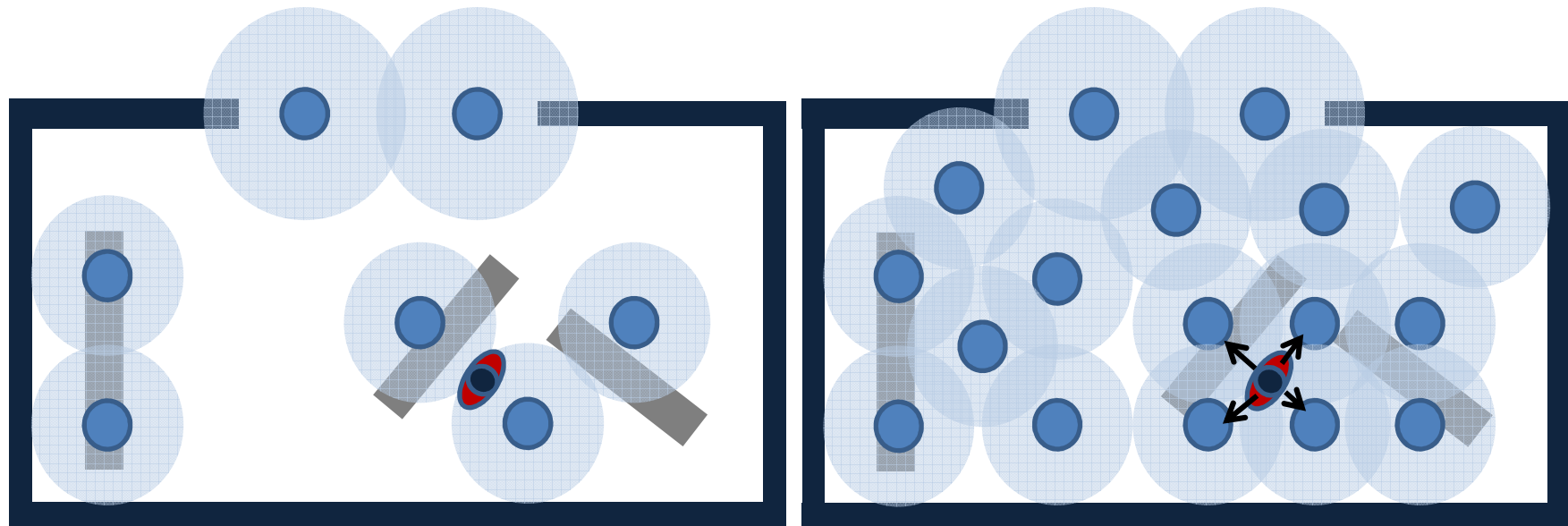


Indoor Location / Proximity Detection



Indoor Location Services and Analytics

Beacon Placement



Lighting allows for **greater coverage** of the space c/w separate boxes. Less cluttered ceilings, less hardware to install and maintain.

Location becomes **more precise** as multiple beacons can be seen by a device



Beacon Types

- There are many ways to configure beacons within the SIG guidelines.
- Two companies have layered some conventions over BLE:
 - Apple with the iBeacon
 - Google with the Eddystone or Uri beacon

iBeacon

- Key inclusions:
 - A proximity universally unique identifier (UUID) (16 Bytes)
 - A major and minor code (each 2 Bytes)
- iBeacons do the following:
 - Alerts
 - Ranging
- Apps can now be made “iBeacon aware” **If the user is *this* close to *this* Beacon, then do *this*.**

Beacon Types



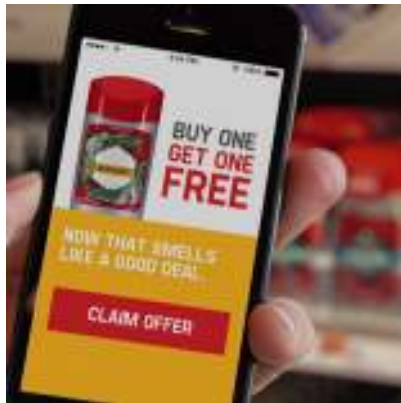
URI or Eddystone Beacon

- The Physical Web is positioned as “interaction on demand”. It uses BLE to advertise from physical things URLs to “whomever is interested” nearby.
- The URL may lead to a simple Web page, an interactive website or a deep link in to a mobile application.
- C/w iBeacon:
 - its open
 - Its not being “interrupt” driven
 - Ultimately no app needed.

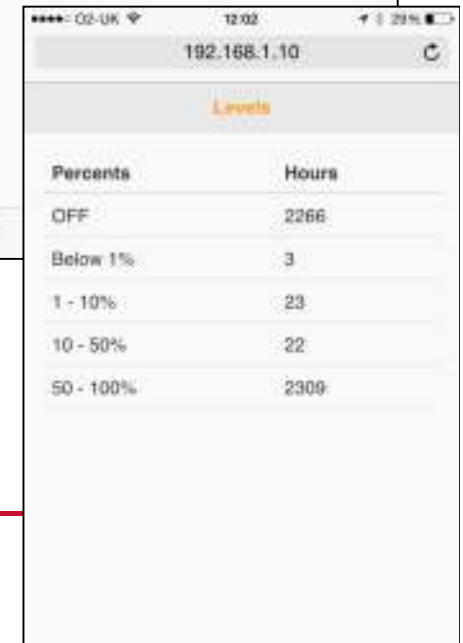
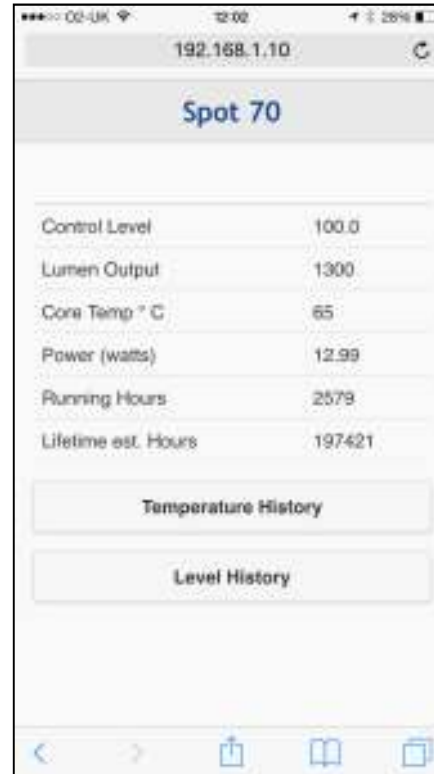
Indoor Location Services and Analytics

If the user is *this* close to *this* Beacon, then do *this*

- **Analytics:** tracking people's movements, how long they stay, where they linger. Space management
- **Interaction:** information on merchandise, works of art etc
- **Way finding** – especially airports
- **Emergency** phone services
- **Asset tracking**



Arup '24:0:0' Exhibition December 2014 to March 2015

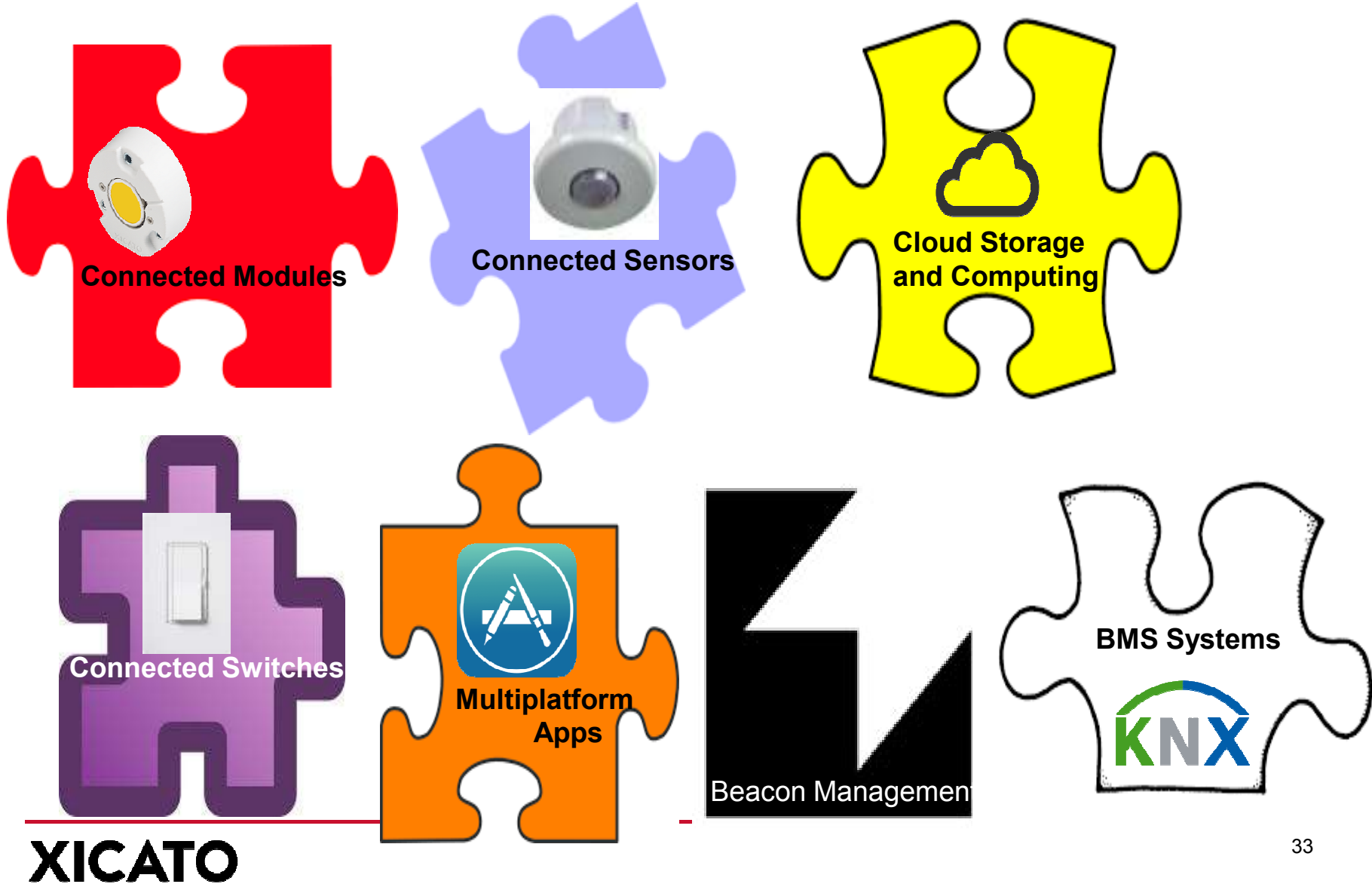


Wrap-Up

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State of Connected Lighting



The Big Picture - Interoperability

