The future of lighting is smart

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What is a smart light and smart lighting?

Smart lights:

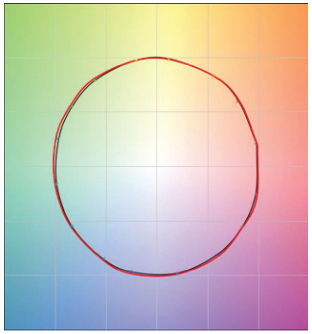
- Light quality
- Monitors internal operating conditions and responds autonomously to fault conditions
- Peer to peer two way communications capability to receive commands and sensor inputs, responding autonomously, and transmit status and event information
- Able to be programmed to modify response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

Smart lighting:

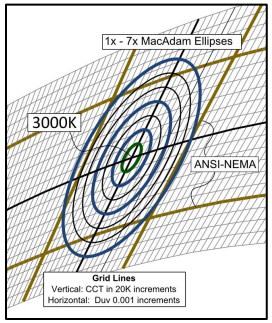
- A combination of smart lights and the software program(s) used to set-up and configuring an installation to behave as we want when an event happens

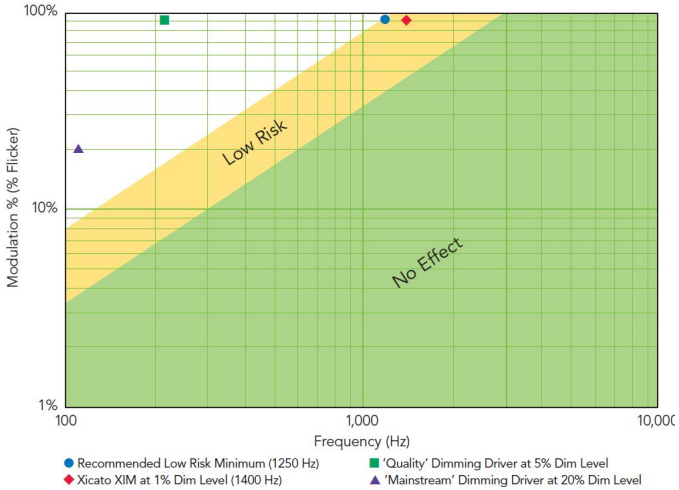
Quality of Light

Color Vector Graphic

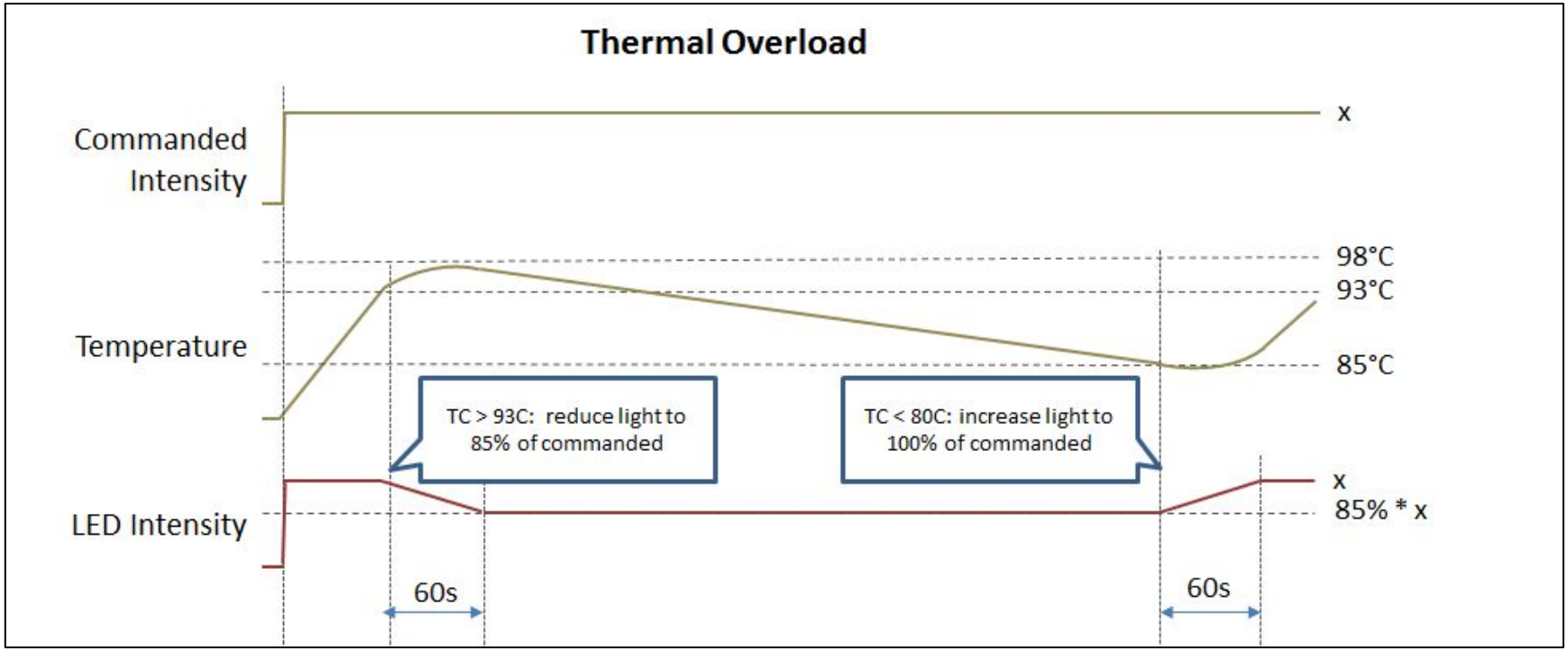


Red line: Xicato source
Black line: reference illuminant





Monitors internal conditions and responds autonomously to faults
Thermal Foldback example



2–way communication
Comparing DALI and BLE

DALI – is it smart?

- YES, in that 2 way communication is possible

- But limited:

  - No autonomous responses to external events. Everything via Master.
    - Very difficult to build multi-layered causal relationships between devices
    - Latency issue - can be unacceptably slow
  - Programming and data collection possibilities limited to DALI standards and what the DALI Master supports

- Provisioning / commissioning far 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

2–way communication
Comparing DALI and BLE

DALI Compared with 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 addition security layers
  - Suitable for local networks: for wider systems gateways needed.

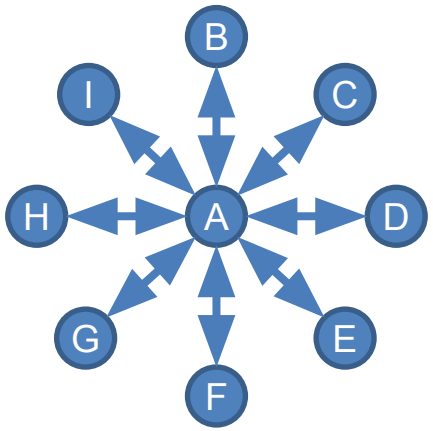
Bluetooth Low Energy – a Brief Introduction

BLE is different from traditional Bluetooth

- Traditional Bluetooth
  - Dedicated pairings. Point to point connections.
  - Designed to support data streaming (e.g., voice/audio)

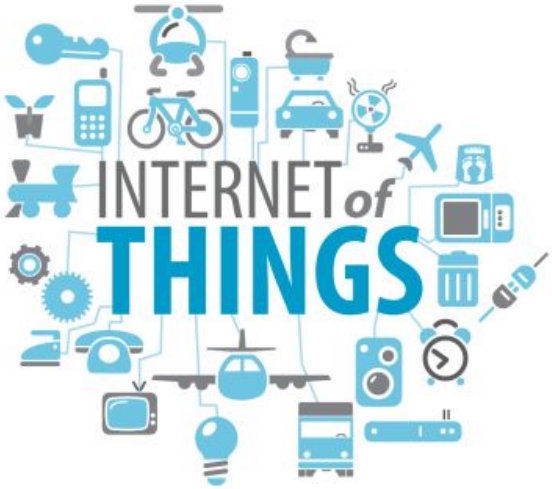
Point to Point

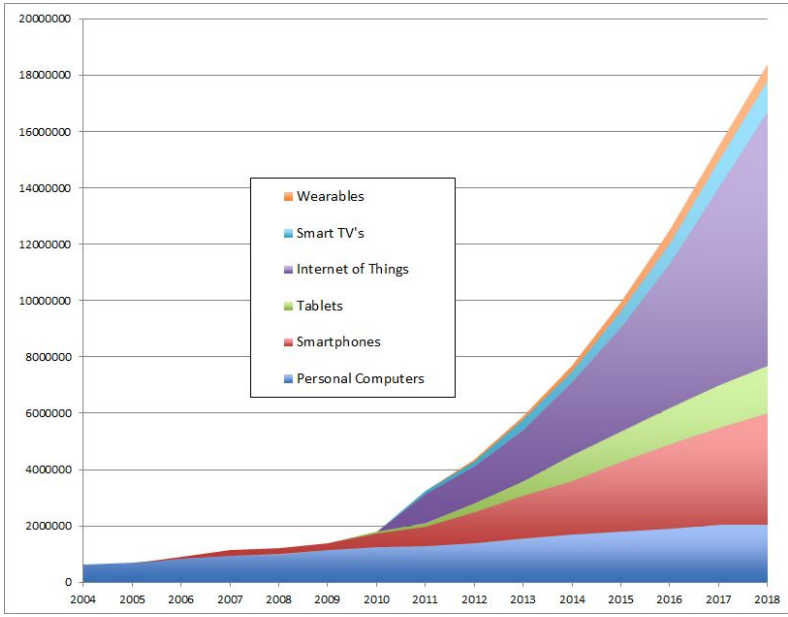
- Bluetooth Low Energy
  - No dedicated pairing – peripherals advertise presence and availability to support connections
  - Star connection topology
  - Small data transfers
    - Device state information (temperature, device ID, light level, turn on, turn off, etc.)
    - Not for large data transactions – 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.





iBeacon

Eddystone

BLE operating principle

0	AD Flags
1	
2	
3	Field Length <0x1B>
4	Field Header <0xFF>
5	Xicato Company ID
6	0x0253
7	Device/Packet Type
8	
9	Device ID
10	
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	RFU
26	
27	
28	
29	
30	Data Protection

- BLE foundation layer and protocols
- OTA codes and APIs
- Advertising packets, scan responses and connections

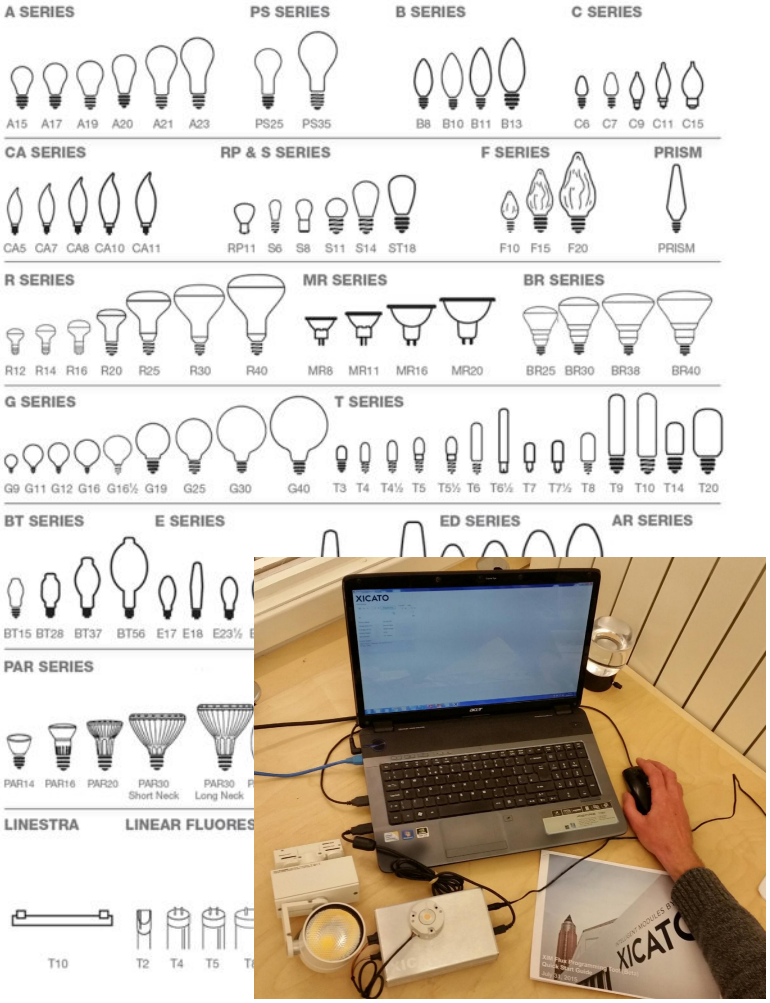
Communication: lighting services

Applications: OEM configuration

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

Configurable smart modules?

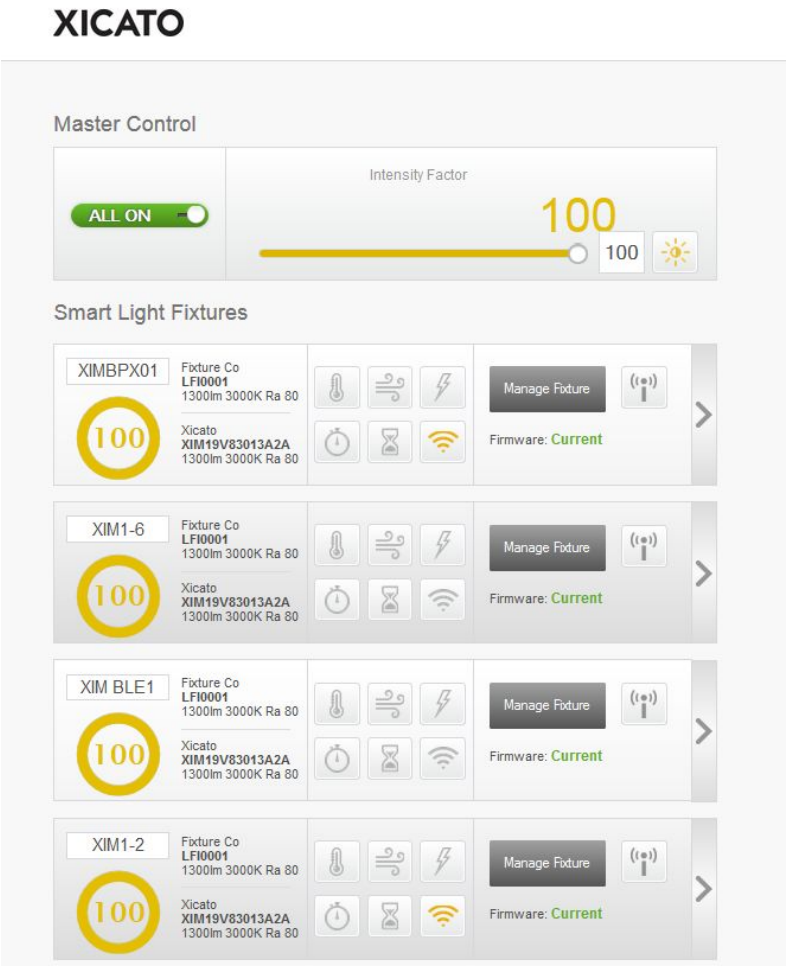
- **Max flux, min flux**
- **Fade-rate**
- **Dimming curve**
- **End of life behavior** (when, how manifested)
- **OEM / fixture information**
- Security in operation (eg thermal capability of luminaire cannot be exceeded)



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
- Set **security access** levels
- **Configure network** connection (DALI, Wi-Fi, Zigbee etc.)

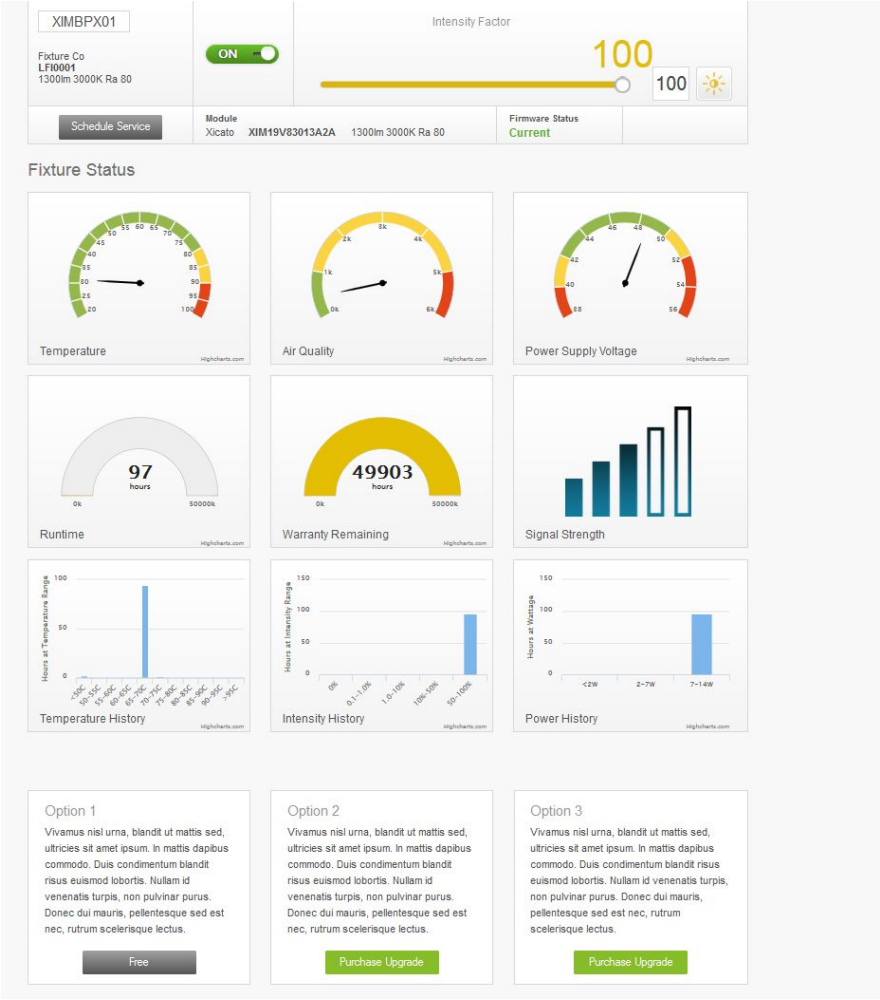


Applications: maintenance and diagnostics

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

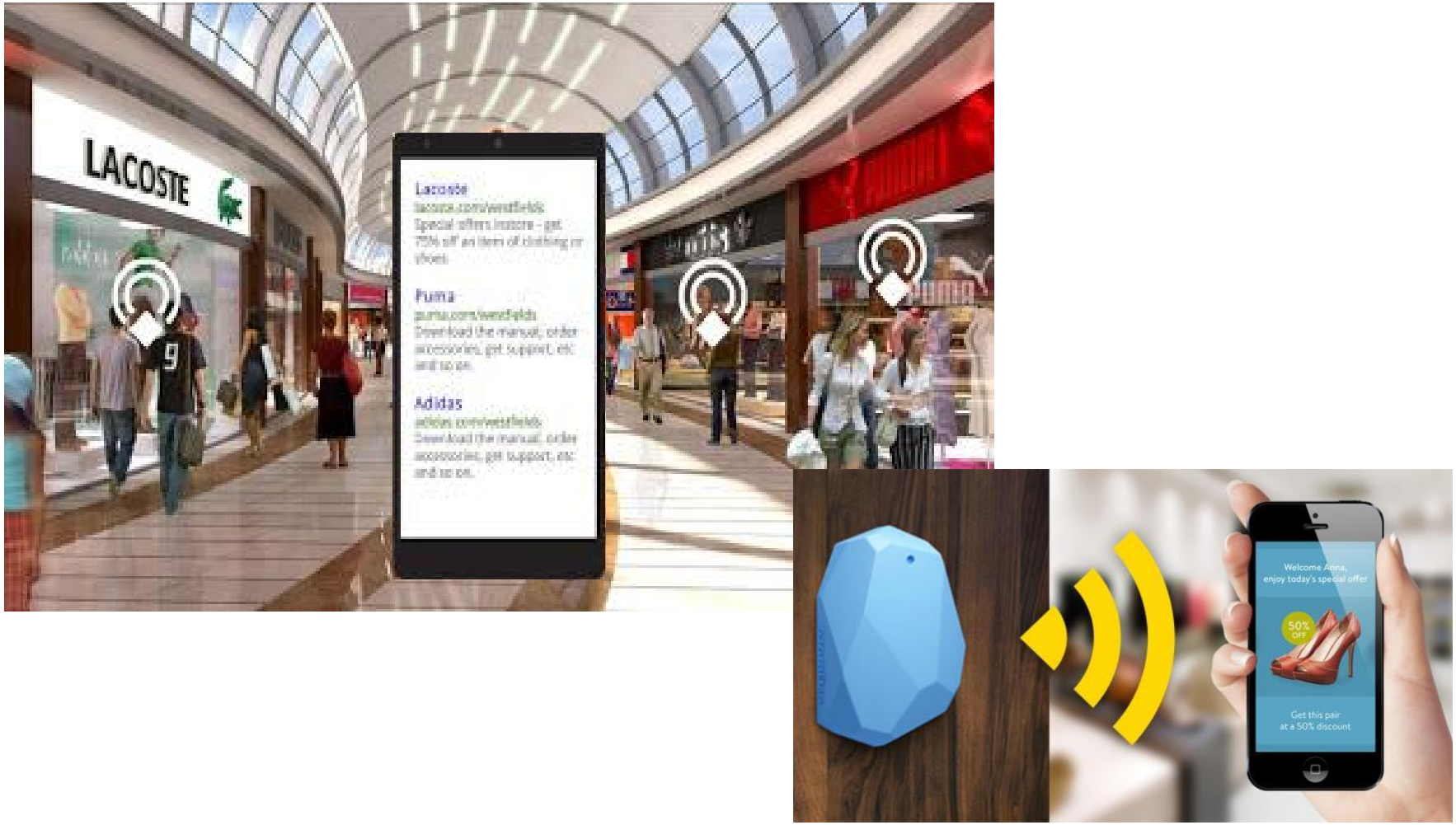
With smart diagnostics:

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

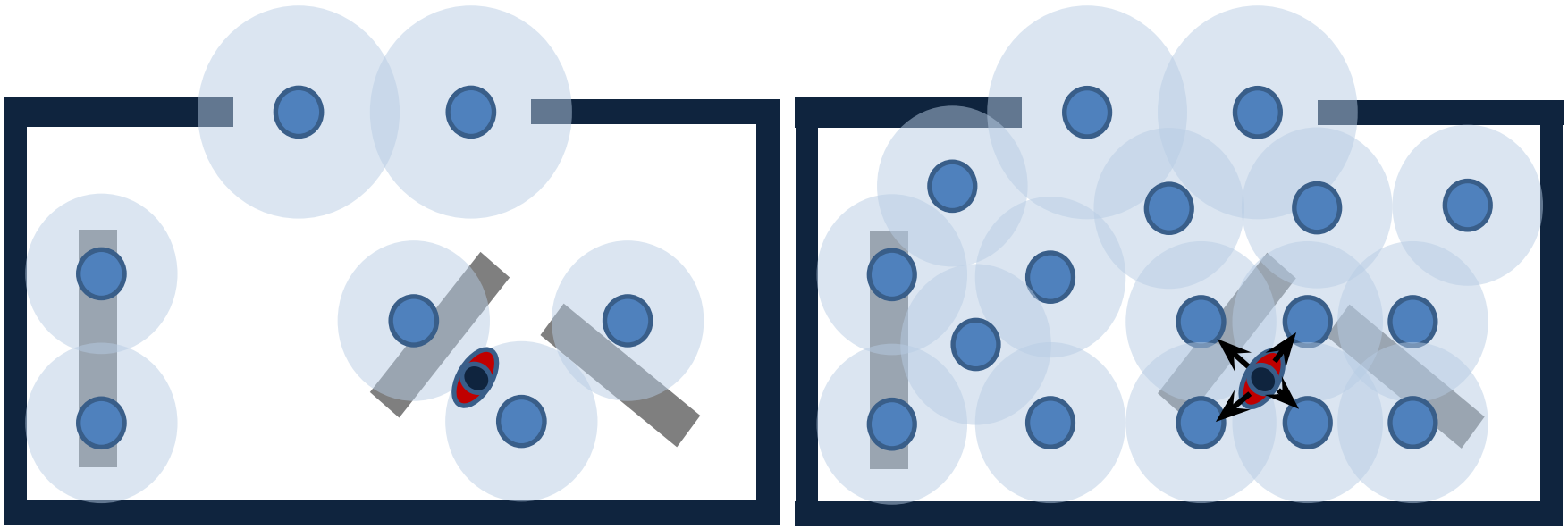


Communication: New Services

Indoor Location / Proximity Detection



Indoor location services and analytics
Beacon placement

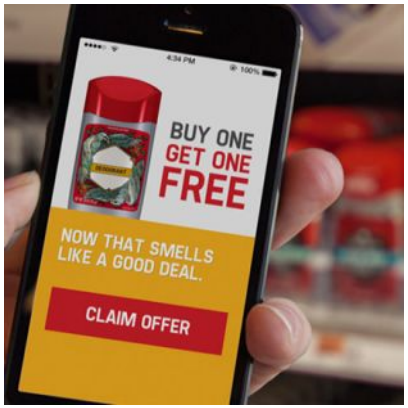


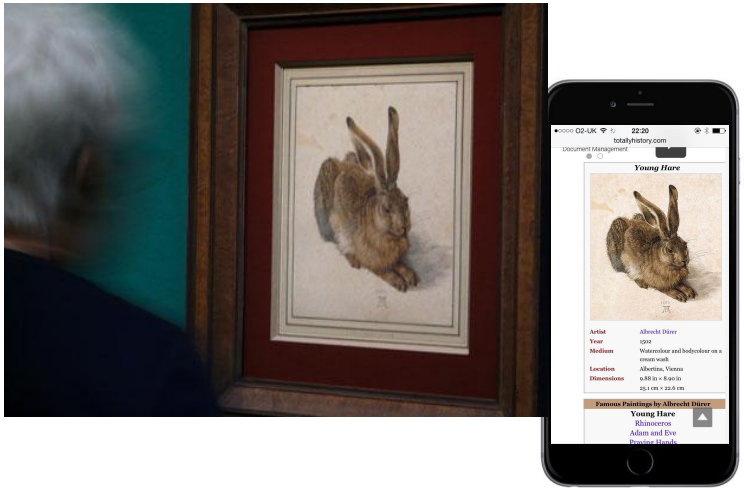
Lighting allows for **greater coverage** of the space c/w separate boxes. Less cluttered ceilings, less hardware to install and maintain.
Location becomes **more precise** as multiple beacons can be seen by a device

Indoor location services and analytics.

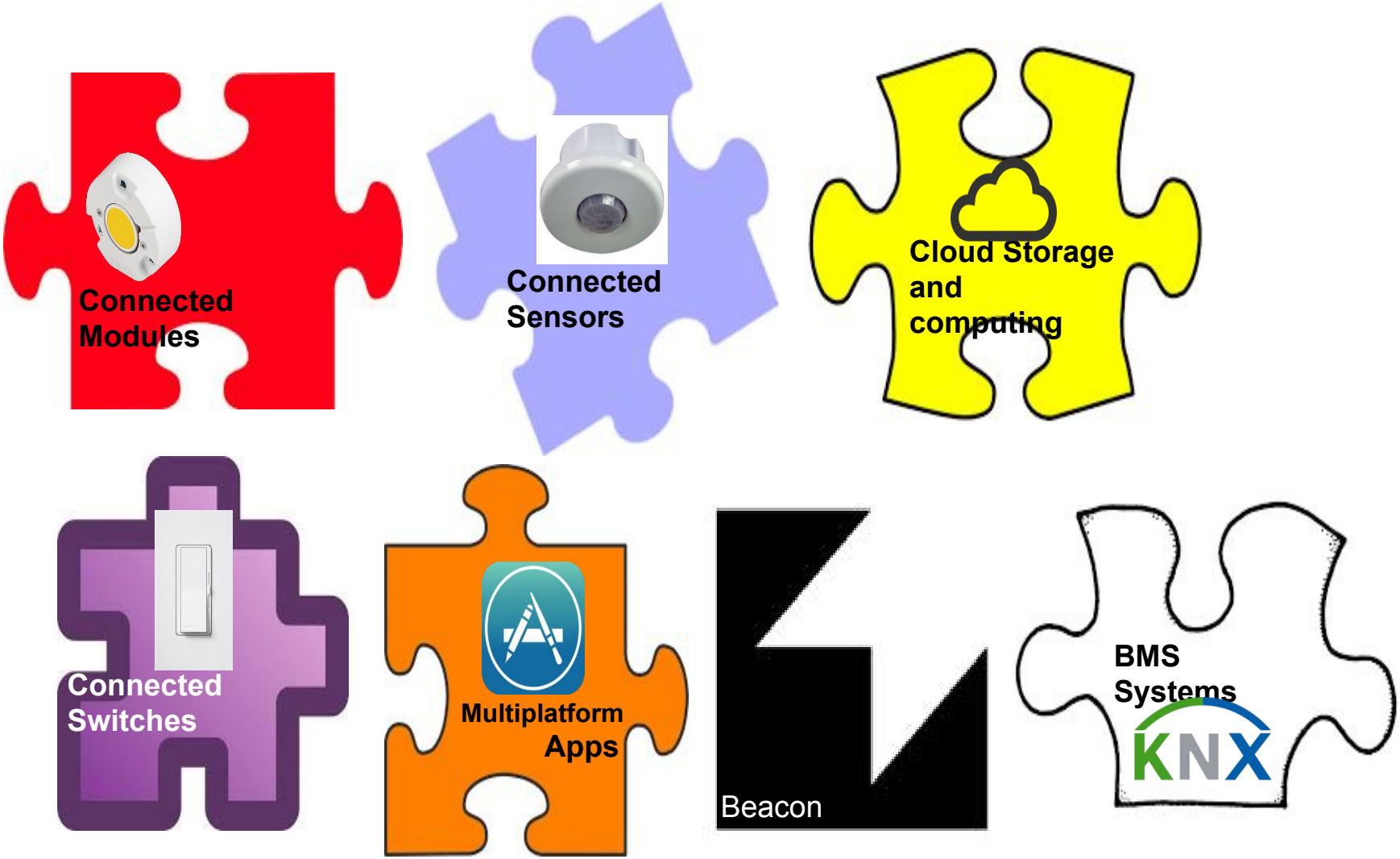
If the user is *this* close to *this* Beacon, then do *this*.

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





State of Connected Lighting



The Big Picture - Interoperability