Reducing Configuration Complexity
The contribution of chipscale integrated solutions

Tom Griffiths
Sr. Marketing Manager
ams AG

November 2015

Agenda

Architecture of IoT smart lighting
Importance of the sensors
The puzzle pieces
Focus on adoption (turn… key…)
A quick case study
Industry's to-do list (an opinion)

The Opportunity of Smart Lighting

Following in the footsteps of recent technologies… from analog to digital to interactive

Pre-Industrial

Analog **TouchTone** **Smartphones**

Little config→ Hard Config→ Simplicity

Mainframes **Orig PCs** **Tablets**

Post-Industrial

A new paradigm connecting lighting, users and the space with new applications, thought processes and market structures

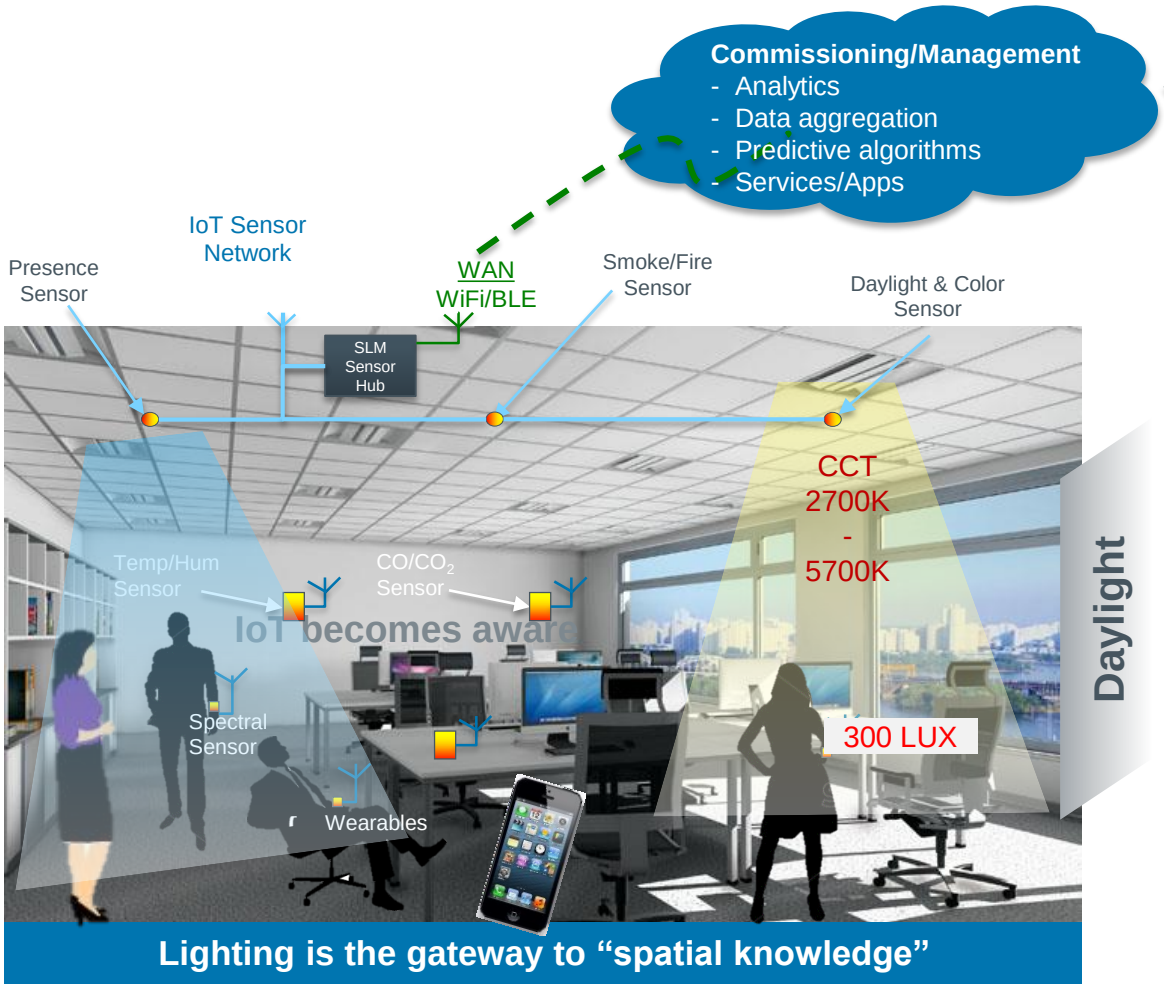
“Sufficient”
Basic Productivity
Utilitarian

2015 - 2020

- “Smart”
- Personalized and Responsive
- Novel form factors
- Predictive & Self-configuring
- The realm of IT

Smart Lighting with spectral cognition

Knowledge (about the space) can drive better configuration decisions…



Lighting is the gateway to "spatial knowledge"

- Lighting characteristics
- Presence/Occupancy
- Environmental sensing
- Specialized spectral sensing
- User data (Wearables)

The Internet of Awareness

….. each luminaire is a sensor hub

Making it intelligent only solves part of the problem

Sensor integration needed – INQUIRE WITHIN

Self-configuration needs knowledge of the space

- Intelligence allows individual access and control
- Luminaire sensor integration and direct sensor access, e.g. lux level, allows some understanding
- Reflectivity and distance from walls can likely be inferred

Lux, CCT, Temp, Humidity are only the beginning

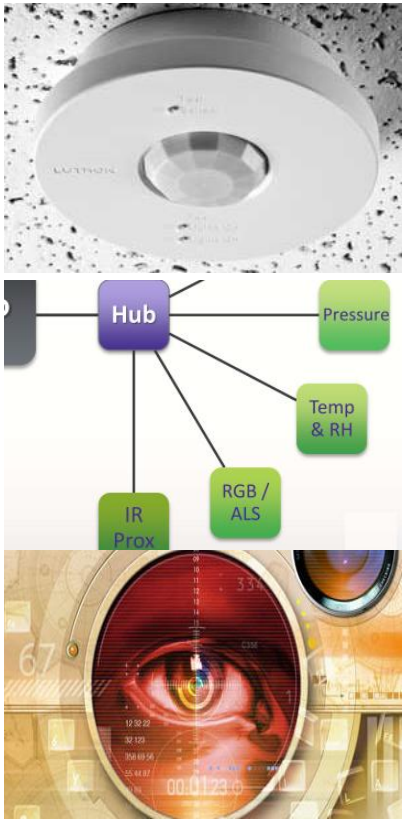
- Furnishing inventories
- Time of flight
- Space mapping

Sensor integration can take over from there…

- Closed loop daylighting, color tuning
- Targets can be varied from uniform defaults

Sensing technologies

The tech is here, and pricing is good (and getting better)



Current capabilities (priced for 1st inflection point)

- Lux - precise, but new paradigms for interpretation
- CCT/Color – interference filters/XYZ/more channels to replace RGB
- Presence – active is good, passive still pricey

Coming sensing capabilities

- Spectral sensing – what does it tell us?
- Time of Flight (ToF) – mapping the space… processor intensive
- Presence – affordable passive combinations

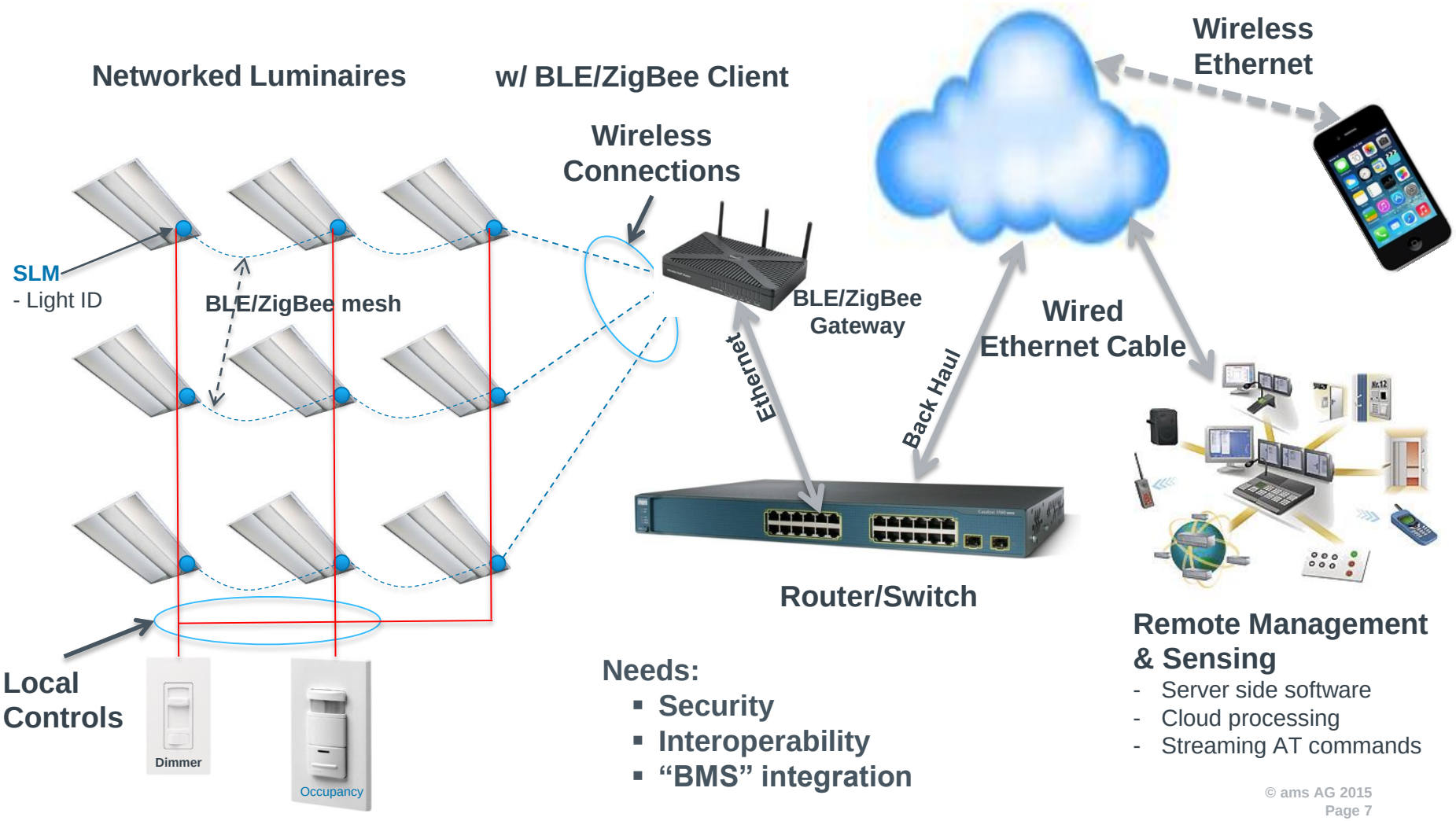
The next big inflection point – pricing for ubiquity

- Lux, CCT/color – cellphones prove that it can get cheap enough
- Presence – Lots and lots of choices
- ToF – Big one for the features

And we can't forget that more dynamic luminaires will have an impact
e.g. adaptive optics (one SKU to rule them all…)

Lots of pieces to the puzzle

Some standards are mandatory



Needs:

- **Security**
- **Interoperability**
- **"BMS" integration**

Simplicity (and reliability) = Adoption

The move to LEDs continues to be painful for many manufacturers…

… just when they get power and heat figured out, here comes networking, BMS/cloud integration and apps??!!

- Systems solutions required (systems on a chip)
- Eco-system approach

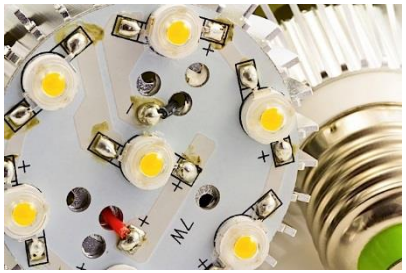
These things need to last a long while

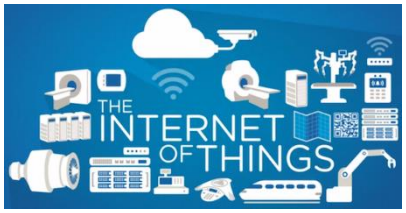
- Good embedded solutions/practices required
- High level of silicon integration
- Lifetime calibrated sensing

The value proposition should be more than just energy savings

- The story is about the personalization and quality of light
- More benefits will be revealed as we all learn more (e.g. health)

Bringing the pieces together (an opinion)





Critical/Standardized performance

- Must-haves: Networking, lux sensing, commissioning algorithms
- Meeting “the standard”: That pesky lux paradigm

Standardized standards

- Networking must be open architecture
- Lots of room for “BMS-level” innovation
- Driverless/high-level command/control interfaces
  - ➢ Opens up separation between commissioning and operating systs

The opportunity - How much can we gain?

- A recent daylighting case study indicates… >50% for properly commissioned daylighting
- More as granularity (and knowledge of the space) increases
- Lighting will provide new answers to the whole building!
- Reshaping the ESCO/facilities – Lighting becomes an IT function

Case Study: A legacy daylighting approach

2013 Commissioning Daylight Controls study

- 20 different spaces in multiple sites
- Could have realized 63% savings if properly commissioned
- Only realized 23% savings because of:
  - Control calibration
  - Incorrect zoning/sensor positioning
  - Incorrect control wiring

…and at a cost of $0.75 to $3/ft^2?!
Integrated solutions will cost-effectively deliver on the full savings …

> [Today's centralized] daylighting controls come with significant additional up-front costs. From a review of relevant literature and from recent project experience, we have found costs can range anywhere from $0.75 - $3.00 per square foot depending on the complexity and flexibility of the system – *ECW study*

Source: "Commissioning for Optimal Savings from Daylight Controls – Energy Center of Wisconsin, 2/19/2013
Project website: http://www.ecw.org/mndaylighting

Sensor-fused intelligence simplifies savings

Integrated smart lighting management allows the full potential of daylighting to be realized

Legacy Daylighting	Sensor-Fused Daylighting
Non-integrated approach	Sensor integrated smart lighting management
Control Calibration	Silicon sensors don’t change
Sensor positioning	No guesswork – built in to the luminaire
Incorrect zoning	Granularity – a sensor in every light
Incorrect wiring	Part of the fixture
Furniture/Reflectivity	Set an in-situ illumination level
Cost $0.75 to $3/sqft	< $0.30/sqft (cheap, but sophisticated)

Source: “Commissioning for Optimal Savings from Daylight Controls – Energy Center of Wisconsin, 2/19/2013
Project website: http://www.ecw.org/mndaylighting

The Industry's To-Do List (an opinion)

Outside the lighting box

Focus on embedded intelligence and sensing

- No sensing blows the IoT story
- Granular information required for good decisions

Promote success (especially DOE)

- "Dumb" LED lighting gets no recognition
  (sorry… no PR for the latest flip-phone)

Let the market rule when it comes to value-add

- Value-add creates the innovation incentive
- Don't undertake efforts to put value-add into public domain

Simple goals

- xx% of new LED lighting shipments sensor enabled
- Tailor incentives and "competitions" to the goals

Facilitate cooperation

- How about a "connected lighting" one-day conference (heh)

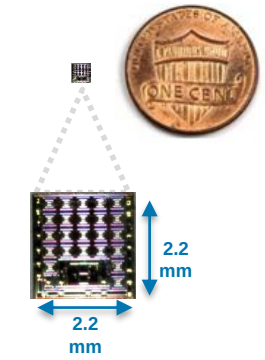
Enabling “real’ smart lighting

Simple Solutions ➔ Mass Adoption

Smart lighting should be simple and human-responsive, connecting people to the space

Sensor-integrated semiconductor solutions have arrived

The IoT’s *Internet of Awareness*™ enables “cognitive” configuration



A sensor-integrated smart lighting manager

IoT Cognitive Lighting!

Aware
Connected
Responsive

Thank you

Please visit our website
www.ams.com/Sensor-Driven-Lighting