DOE SSL R & D Workshop – February 2017

Lighting Integration into Buildings: The Sensory System

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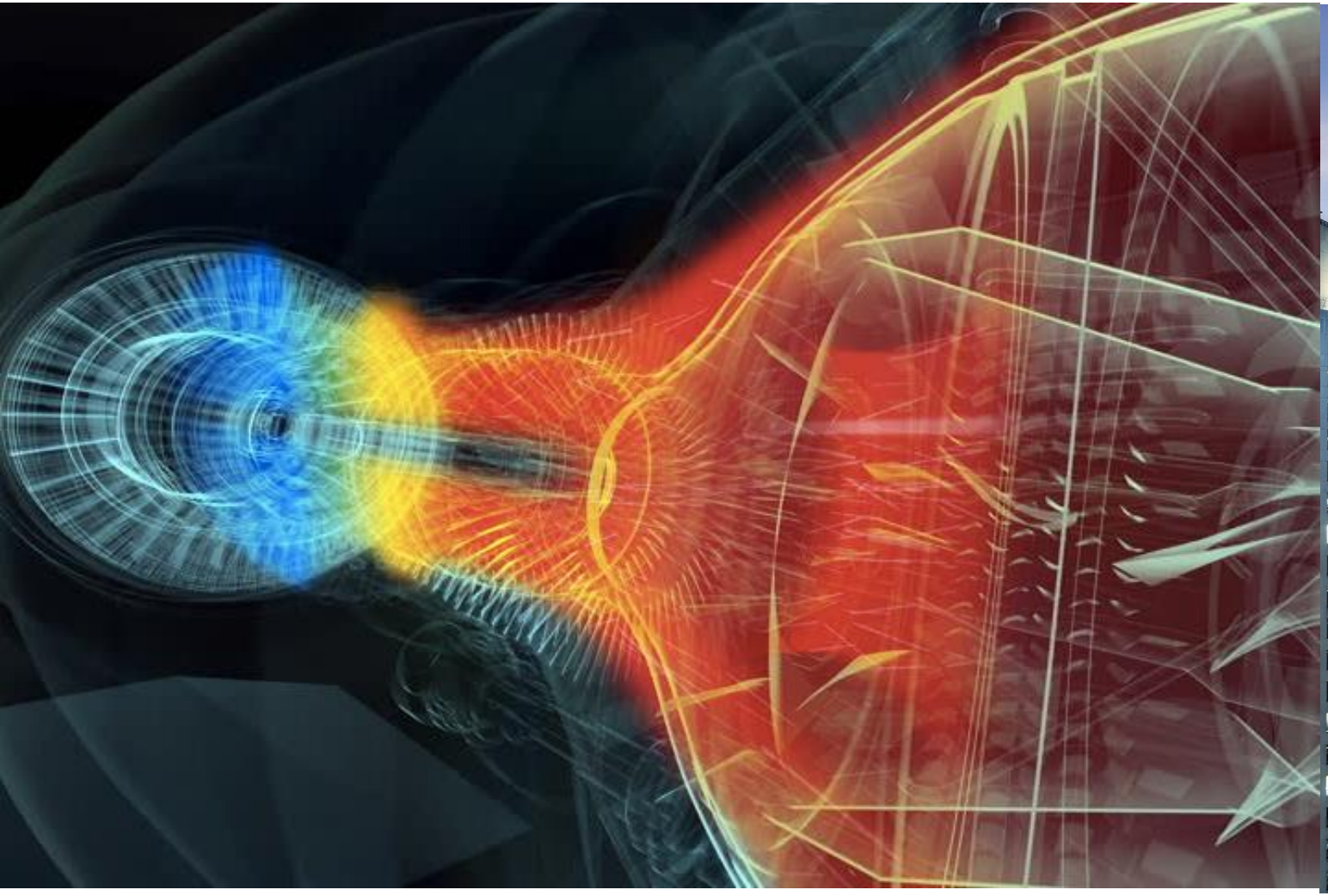
Scaling Data



Small Things, Very Big Data

Big Things, Very Small Data

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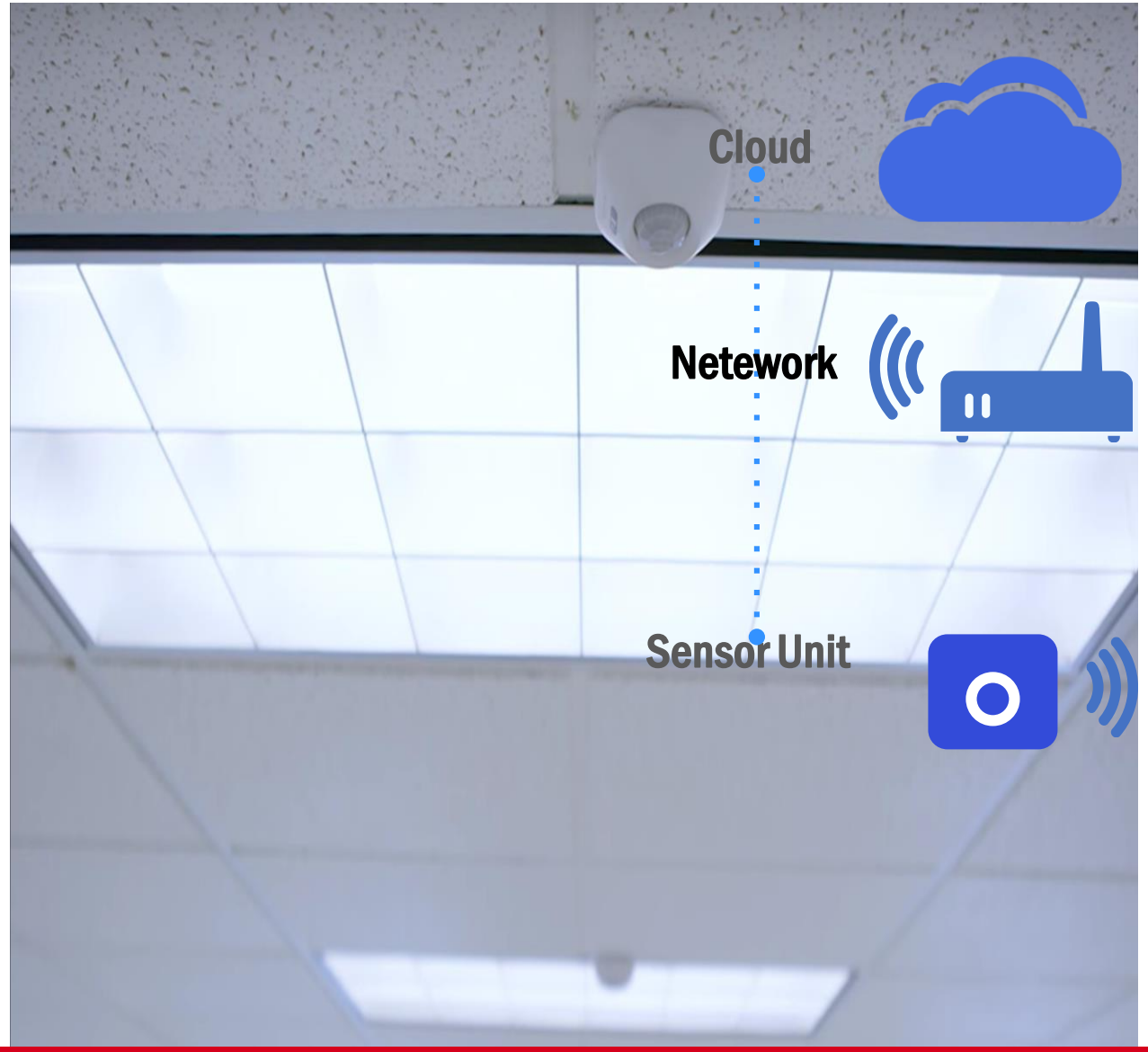
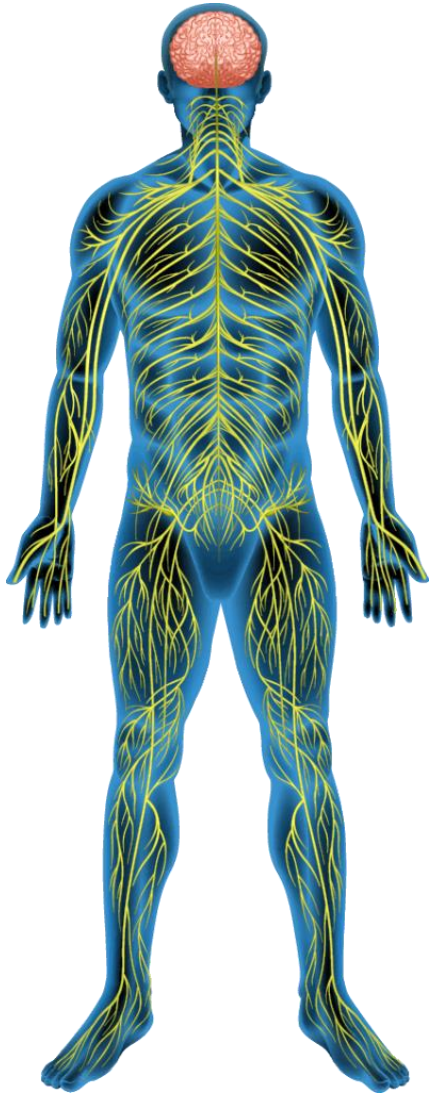
Start with the Data

- Big Data
  - Heterogenous data
  - Need to Capture, Aggregate, Store, Analyse
  - 3 Vs: Volume, Velocity, Variety
  - How Big?
    - Jet engine generates Gigabytes (10^9) per hour of data
    - Stock Exchange trade data: Terabytes (10^{12}) per day
  - Information content may be *unknown*
- Data Science
  - Focused – closed-ended questions
    - What is the optimal service interval for bearings on my machine, given the vibration and failure data that I have in my database?
  - Exploratory – open-ended questions

Gathering Data - Building Nervous System





Brain-
Central Processing

Nervous System-
Transmission Backbone

Hands-
Sensors,
Actuators

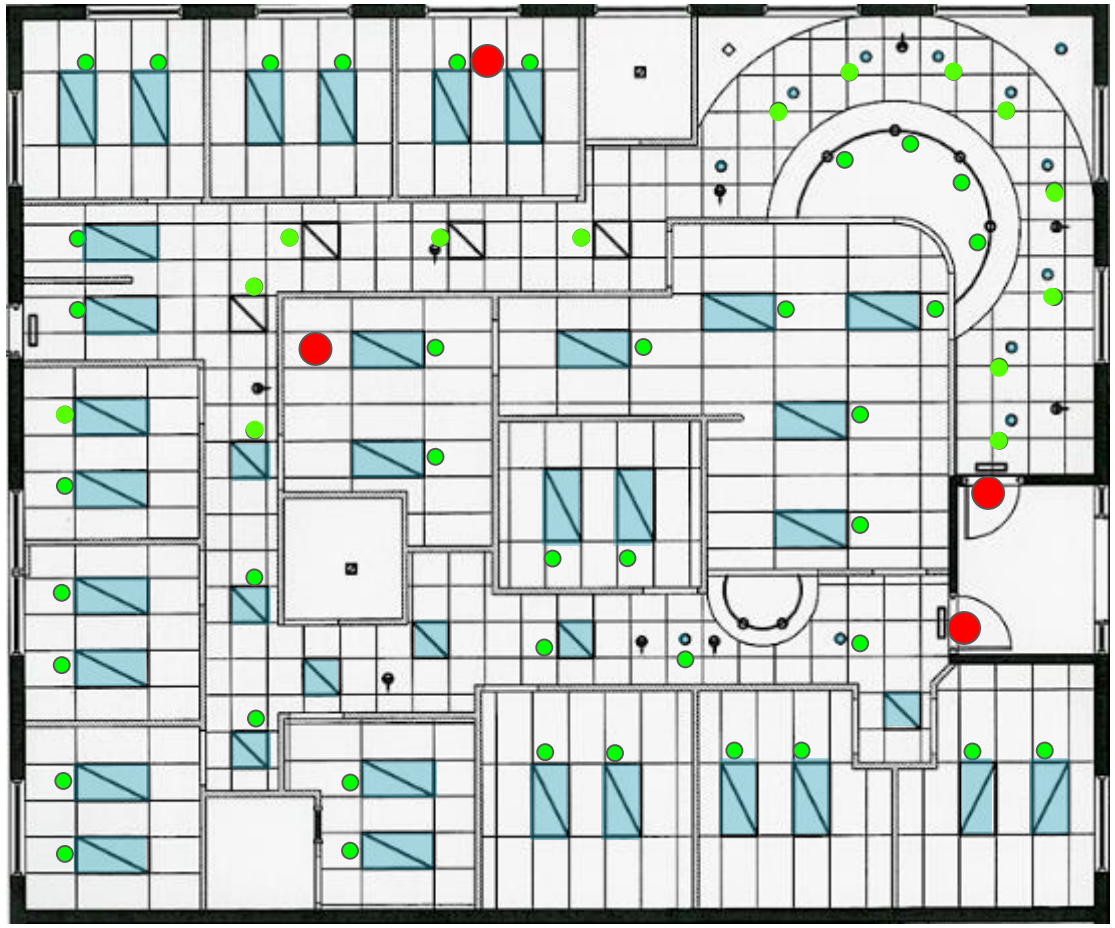
Sensors- The Building's Fingertips

- Our mobile device "friends" are rapidly improving the sensor elements
- Some current and future sensory modes:
  - Ambient light
  - Temperature
  - Humidity
  - Air quality
  - Occupancy
  - Sound
  - Vibration
  - 2D machine vision
  - 3D machine vision
    - Visible light, radar
- Interaction with other devices
  - More radios
  - Visible Light Communication

Sensors: The Building's Fingertips

- Early sensors were Ceiling-mounted
- Sensor size decreasing, capability increasing
- Most sensors now are luminaire-integrated
- New (non-lighting) sensor positions are emerging

Sensory System is about Scale



Smart Sensor Grid

- Typical luminaire coverage – 1 fixture / 100 SQFT
- Smart Sensor Placed at Every luminaire

Light Fixtures

Enlighted Smart Sensor

Employee (Occupancy)

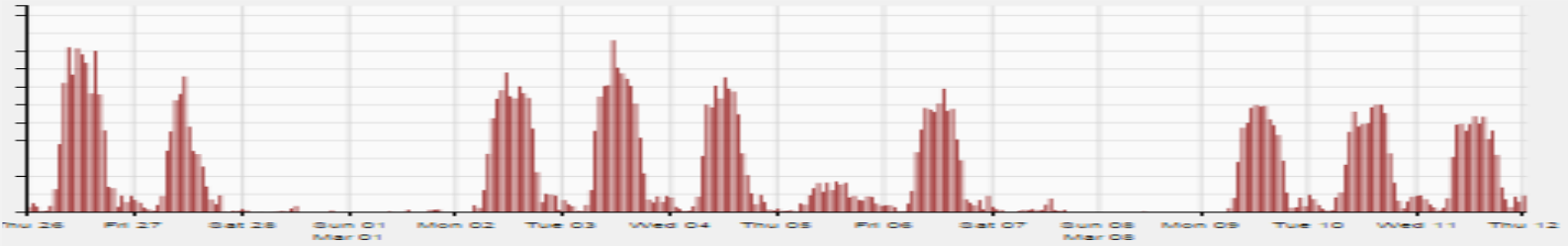
Enterprise Buildings - IOT Opportunities

$/sq foot/month

Enterprise IOT - Applications

- Optimize efficiency
    - consolidating workspaces
    - reducing underutilized spaces
    - Increase productivity based on movement patterns and groupings
- Extensive reporting with graphs, square footage cost estimates, and more
- Deliver improvements in
    - Workspace and conference room utilization
    - Building flow
    - Security and janitorial sweeps

Using Building Utilization Patterns To Optimize HVAC



- Demand-driven heating and cooling
- Powerful but easy to use
- Integrates with the existing Building Management System
- Rich reporting and monitoring via BMS

* Buildings with pnumatic controls can save up to 40%

Timescales

Product life cycles

- Tech Industry – change phones/laptops every 2 years
- Building Industry – Buildings designed to last 25 years
- Lighting Industry – 10+ year life

How can we reconcile these different time frames?

Lighting and Enterprise IOT: The Pressing Issue

- The Lighting Industry (and building industry) is dominated by first-cost considerations
- Retrofit cost is dominated by labor and logistics
- Every LED luminaire installed **without** a future-proof sensor is a lost opportunity

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Thankyou