Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [Potential applications for VLC]
Date Submitted: [10 May 2008]
Source: [D C O'Brien] Company [University of Oxford]
Address [Department of Engineering Science, Parks Road, Oxford, OX1 3PJ,UK]
Voice:[+441865273916], FAX: [+441865273906], E-Mail:[dominic.obrien@eng.ox.ac.uk]

Abstract: [Applications for VLC]

Purpose: [Information]

Applications for VLC

Dominic O'Brien

Lubin Zeng

University of Oxford

Applications (1): Ultra-low power VLC

- **Energy efficiency becoming increasingly important**
  - High efficiency lighting
  - 'Green Radio'
    - IT is 2% of all greenhouse gases
    - Estimates that IT can save 30% of global emissions
  - Particular standards: compromise between
    - complex signal processing
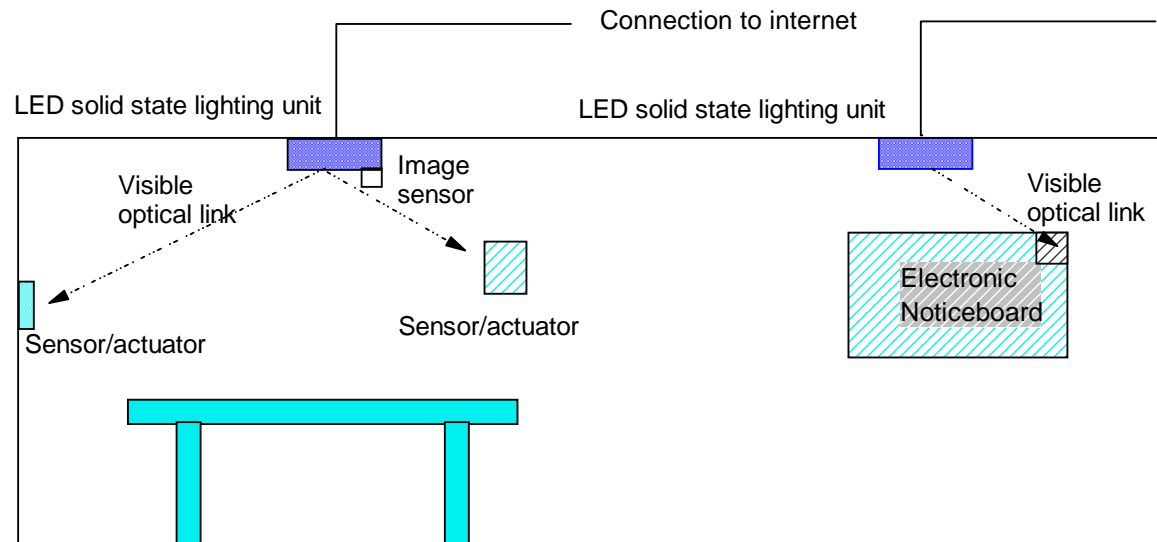   - Requirements for low power

Context

- Moving to an 'Internet of things'
- Possibly 100's of devices per person
- Concerns about privacy and control

Features of VLC

- ## Energy
  - ### Significant energy in transmission beam
    - Easily 'harvested' with solar cell
    - Possible to self-power devices (although challenging)
  - ### Associated with solid-state lighting

- ## Aesthetics
  - ### Visible security

Suitable applications: low power building information infrastructure

Connection to internet

LED solid state lighting unit

LED solid state lighting unit

Visible optical link

Image sensor

Visible optical link

Sensor/actuator

Sensor/actuator

Electronic Noticeboard
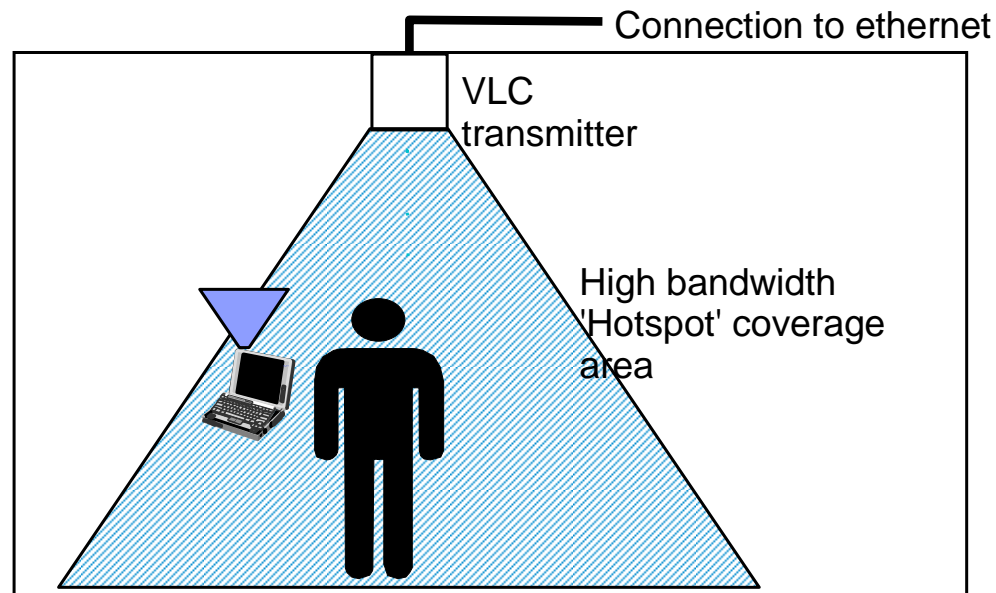
Description

- '**Base station**'
  - Lighting units

- **Smart 'tags'**
  - Building control
    - Can provide information about surroundings to building control
    - Can act on instructions from control system

Ultra-low power requirements

- **Base Station**
  - Communications does not degrade illumination efficiency
  - Compatible with dimming
  - Connection to infrastructure
- **Tag**
  - Low powered (no battery)
    - Energy harvesting, storage, powered by illumination
    - Illumination intensity available 1.5W/m^2 at 400 lux
      - ~mW of power available for signboards
      - ~μW available for sensors/actuators (1cm^2)
- **Target data rates**
  - 10s of bits/s for self powered
- **Used for**
  - Controlling the building, and assisting users interacting with it
  - Low power communications infrastructure

Applications (2): Information broadcast

- ## Solid-state lighting offers an existing infrastructure
  - Small modification for VLC

Connection to ethernet

VLC transmitter

High bandwidth 'Hotspot' coverage area

Information broadcast description

- # Base station
  - – Lighting unit
  - – Connected to information infrastructure
- # Terminal
  - – Receiver
  - – Memory
  - – Display

Information broadcast requirements

- Base station
  - Compatible with dimming
  - Possible uplink receiver

- Terminal
  - Direct information display
  - Local buffering
    - 'Illusion of interactivity'
    - Restricted intranet

- Target data rates
  - ~100Mb/s and above

- Used for
  - Transport infrastructure
  - Intranet broadcasting

Conclusions (1)

- ## VLC has unique characteristics
  - 'Tied' to energy conservation through solid-state lighting
  - Potential to use beam to power terminals
- ## Opportunity to consider when standardizing
  - Ultra-low power case is attractive
  - Important for 'Internet of things'

Conclusions (2)

- **Information broadcasting combined with storage offers potential for**
- **Restricted intranet**
- **Useful for**
  - Transportation
  - General information broadcast