FROM RESEARCH TO INDUSTRY

cea tech

leti

LIFI AT LETI

.

MARTIN GALLEZOT

JUNE 10, 2015

LED Lighting:
Energy efficiency and more than lumen

Lighting = 20% of world electricity consumption

Efficient sources

Smart use of the light

Solid State Lighting

FROM LED TO SMART LIGHTING

Lighting systems

- Luminaire network
- Communication: *luminaire to luminaire, luminaire to building…*

Luminaire

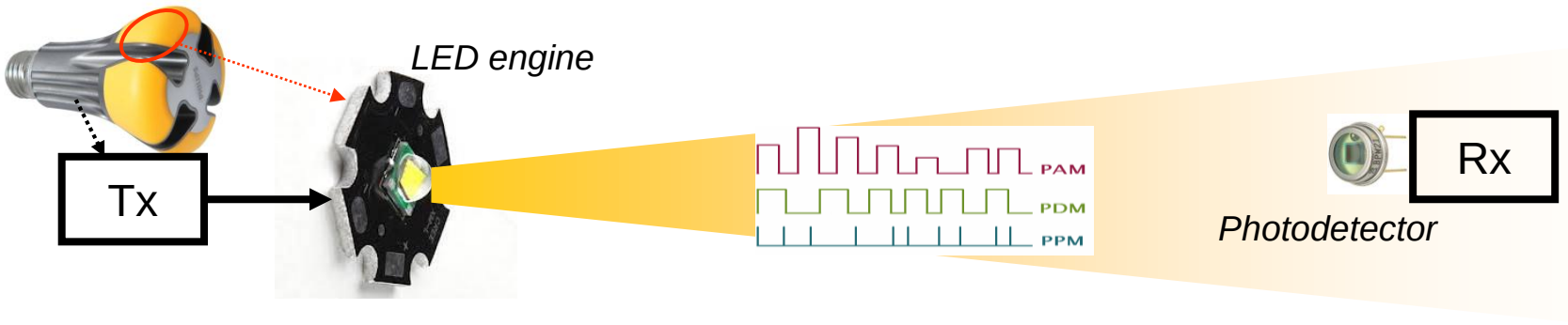
- Light source
- Optics : *no glare, beam quality, flux, efficiency…*
- smart sensors integrated: *presence, ambient light, activity, time…*
- Driver, dimming, CCT adjustment…
- Communication means

- LED chip
- Heat management
- Smart devices

LED

Intensity Modulation on LED forward current

- LiFi uses a real baseband signal to achieve intensity modulation on LED current with direct detection at the receiver



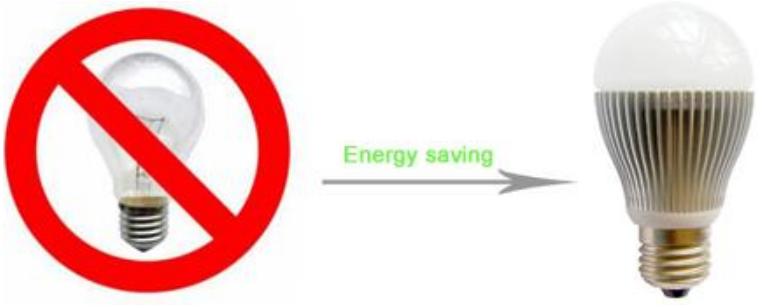
- Goal: use good properties of LED to be modulated at high frequency to transmit information at very high data rate and/or high ranges

- Digital modulations
  - OOK, NRZ, …
  - Pulse: PAM, PPM, PWM,…
  - CSK
  - Multi-Carrier modulation: OFDM, DMT, …

- Standardization (IEEE 802.15.7): no multi-carrier waveform up to now

A REAL OPPORTUNITY FOR VLC

RF spectrum saturation and growing demand



LEDification in progress

SSL offers a dense network

- In every place
- A strategic position
- Energy for free

(SOME) ADVANTAGES OF LIFI

- Transmission with no RF emission
- No sensitivity to RF interferences
- Will benefit from LED massive deployment: 70% of lighting market in 2020
- Security: walls block LiFi signals
- “You see what you get” effect

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APPLICATIONS

Hospitals

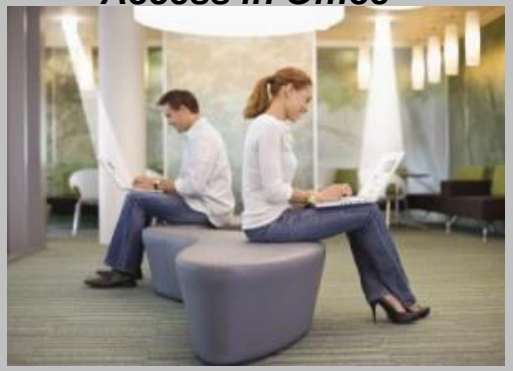
Aeronautic

Retail/Museums

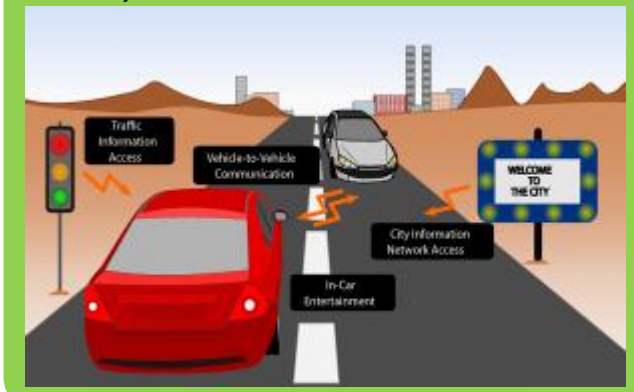
Indoor GPS

Home high data rate access

Access in Office



V2V, V2Infra communications



Pour transmettre des données en LiFi, une LED posée au plafonnier et un capteur intégré à la tablette suffisent. © PSA Peugeot Citroën

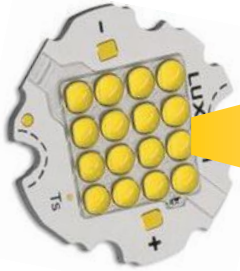
LIFI CHARACTERISATION TESTBED

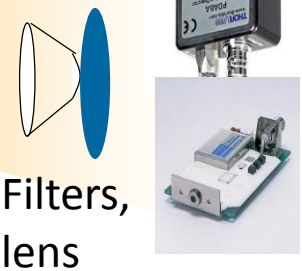
Power supply

Arbitrary generators

Coupler,
Bias-T

LED engine



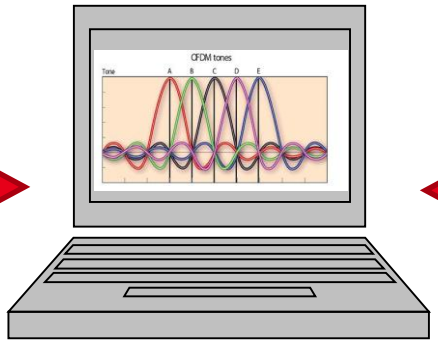


Filters,
lens

Photodiodes

Oscilloscopes

Analyzers

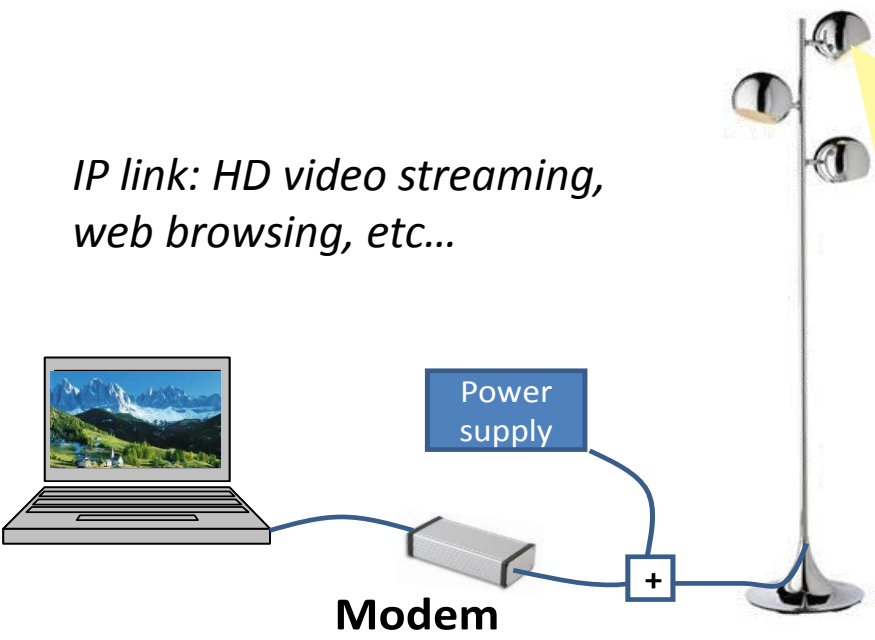


- Optical Hardware qualification
- Optical propagation channel analysis
- Algorithms with hardware-in-the-loop

Software-based modems
with spectral analysis (signal, SNR)

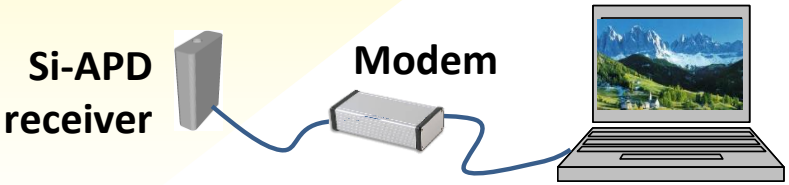
HARDWARE DEMONSTRATOR

IP link: HD video streaming, web browsing, etc…

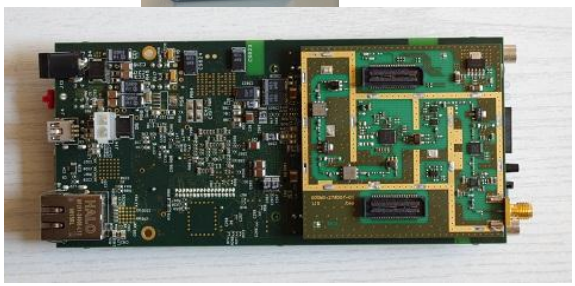


Lighting specs
- 1000 lm
- 120 lm/W
- CRI 85

20Mbit/s, 3 to 5m

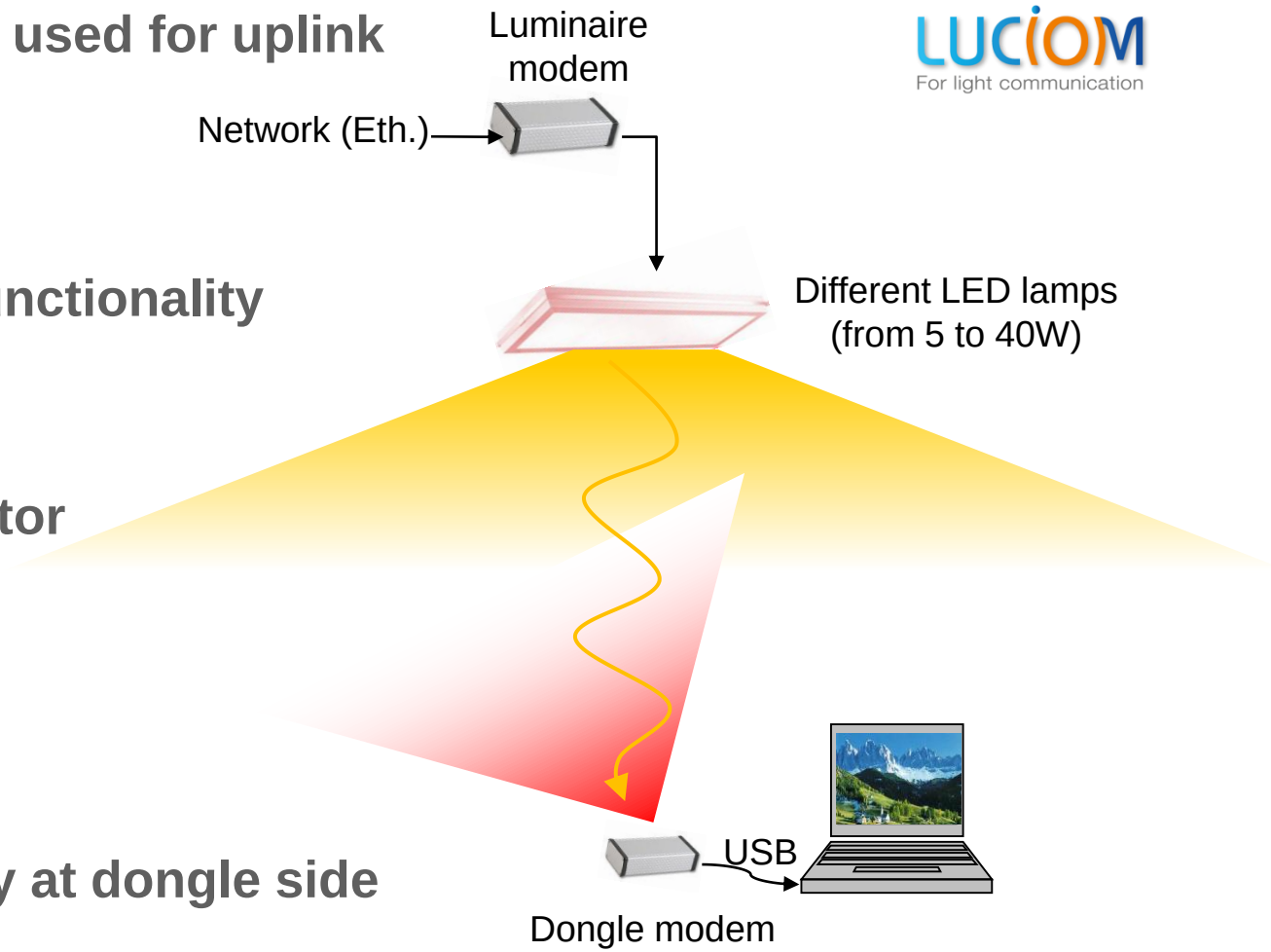


Modems (FPGA+ARM) (Q1 2014)
- Multicarrier waveform – 8MHz BW
- QPSK up to 64 QAM modulation
- Synchronization, AGC, channel equalization, ….
- Up to 30 Mbps (64-QAM 3/4)



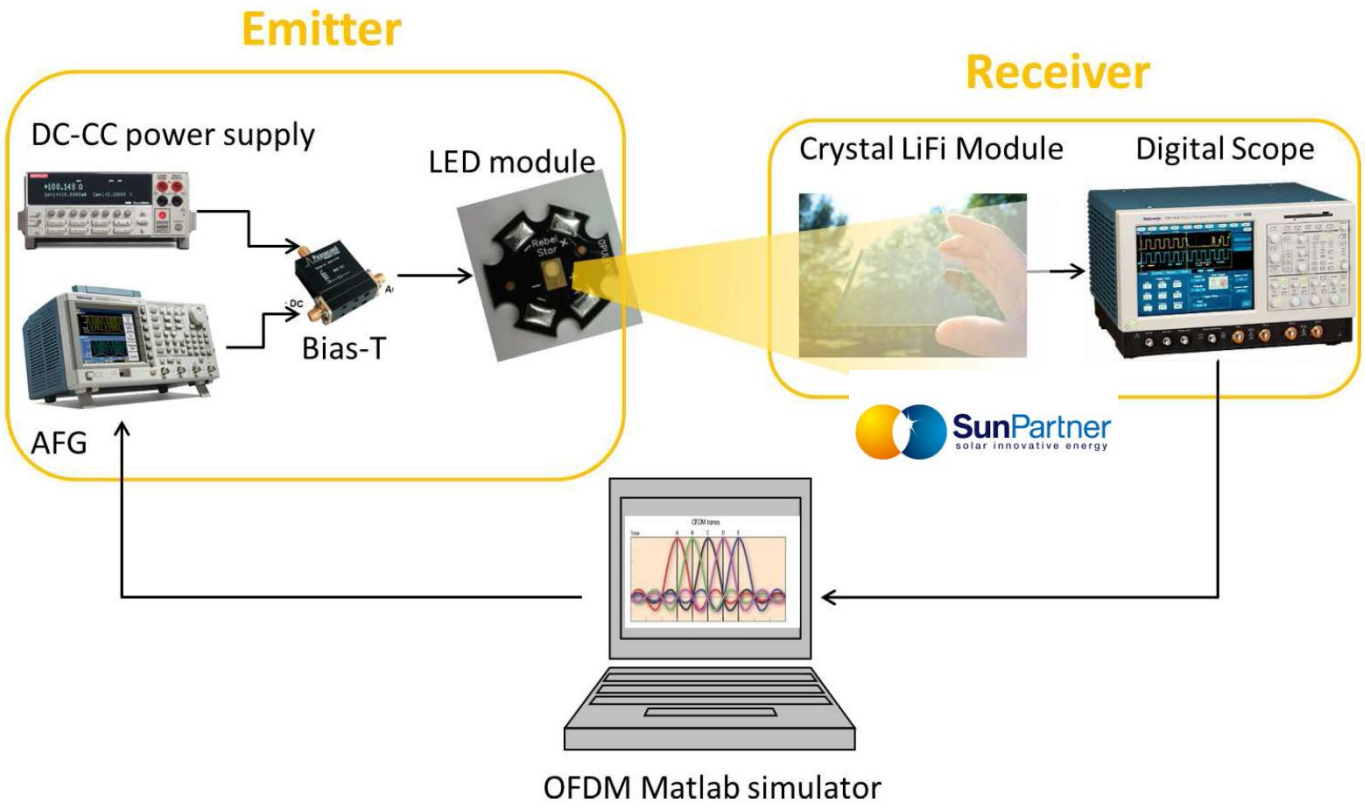
ONGOING WORK (1/2)

- **Infrared spectrum used for uplink stream**
- **Multiple access functionality**
- **Reduced form factor**
- **USB power supply at dongle side**

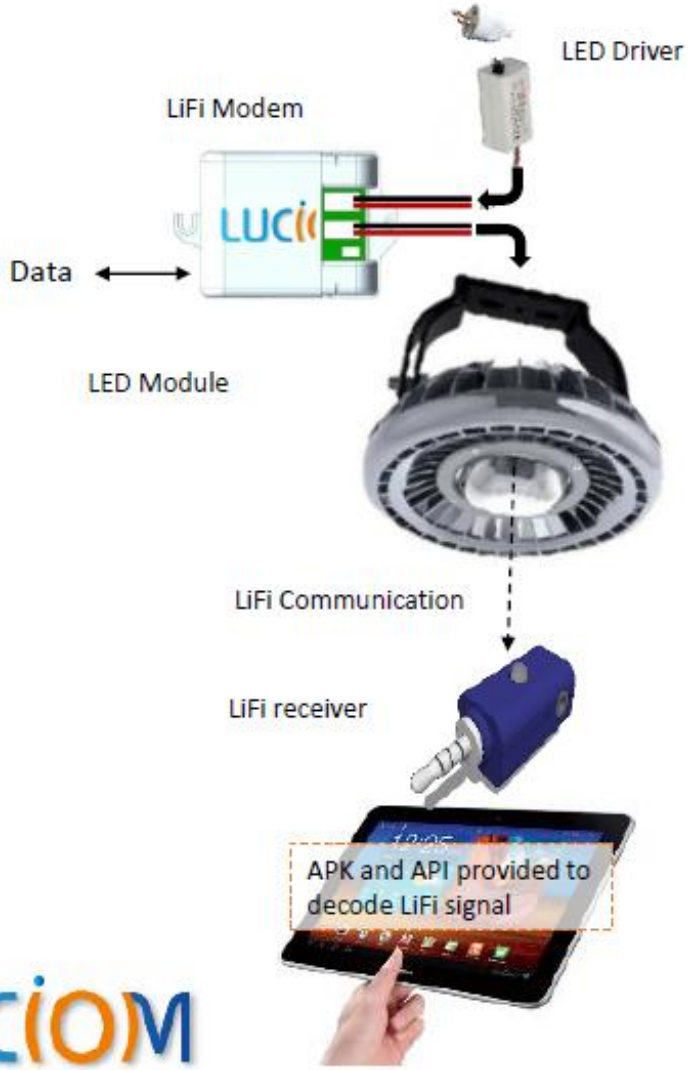


COLLABORATION WITH SUNPARTNER TECHNOLOGIES

→ Indoor/Outdoor VLC High Data Rate Reception Using Semi-Transparent PV Modules



Une approche simple



LUCIOM
For light communication

Des **produits industriels**:

- **Emetteurs LiFi** Bas, Moyen ou Haut débit
- **Récepteurs LiFi** Bas, Moyen ou Haut débit

Des **briques logicielles** de mise à disposition des données transmises via la lumière

Des **Services de personnalisation** des solutions existantes

L'Offre Luciom

Produits « étagères », compatibles avec tout éclairage LED

Produits standard en marque blanche: Votre marque sur nos produits

License R&D: adaptation à vos contraintes, intégration à votre électronique

REMAINING CHALLENGES

Communication

- Uplink performances
- Single Point to Multi point
- Multipoint to Single point
- Channel Interferences
- Bandwidth
- Throughput / Range
- Dimming compatibility
- Backhaul

Optical

- Eye safety, flickering
- Keep good IRC: color rendering, temperature
- Maintain life span of LED
- Work on RGBA Tx and Rx
- Work on components (high speed LED in AsGa,…)