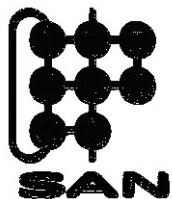


# Semantic Interoperability in a Heterogeneous Smart Lighting System

S. Bhardwaj, T. Ozcelebi, J. J. Lukkien, R. Verhoeven

*s.bhardwaj@tue.nl*



System Architecture  
and Networking Group

**TU** / **e**

Technische Universiteit  
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Where innovation starts

# Outlines

- **Introduction**
- **Background**
  - **OSAS introduction**
- **System architecture**
- **Services and subscriptions for HSLS**
- **Experimental results**
- **Conclusions**



# What is Smart Lighting

- **A smart lighting system** refers to a system where multiple luminaries with actuators and light sensors are connected in a network, and cooperate to meet the requirements of users.
- A smart lighting system composed of two or more heterogeneous networks based on different platforms is called a **Heterogeneous Smart Lighting System (HSL)**.

# Background

- **Approaches to IP integration of WSNs so far:**

## **Pure TCP/IP solutions:**

- **Sensor nodes implement the TCP/IP stack (or a compatible protocols such as 6LoWPAN in 802.15.4 networks)**

## **Gateway solutions:**

- **One node acts as an application layer gateway (e.g. base station), to make the lower layer protocols from both networks (e.g. TCP/IP, IEEE 802.15.4) transparent and to route information.**

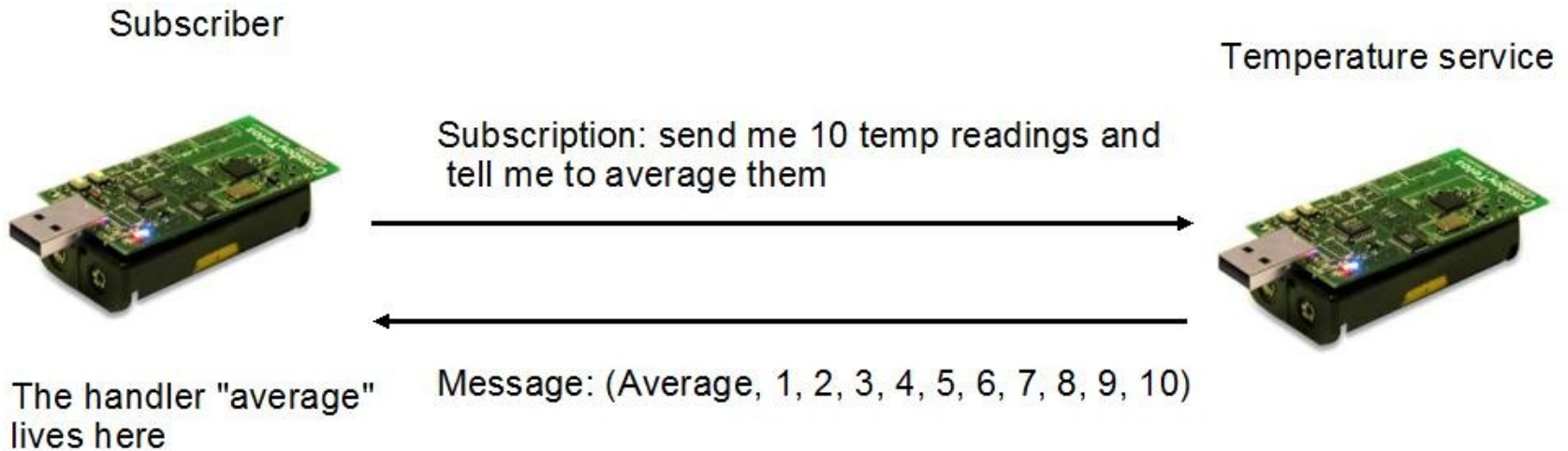


# OSAS

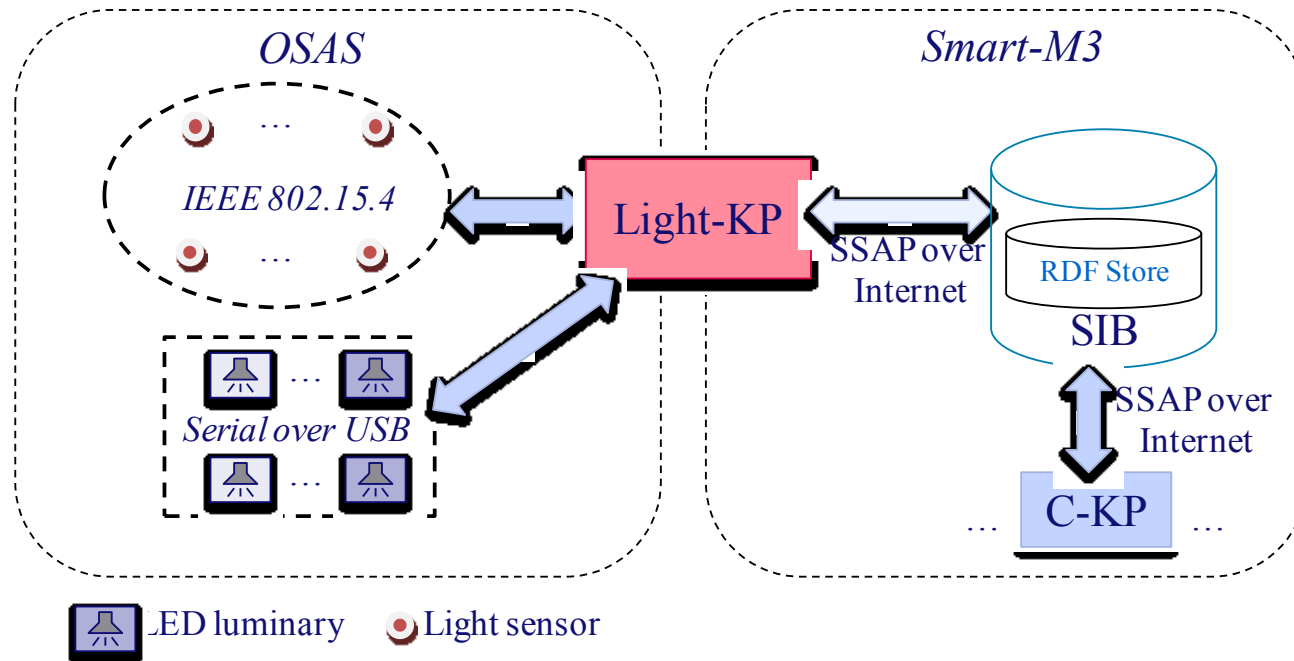
- **Open Service Architecture for Sensors** is an integrated environment for programming wireless sensor networks.
  - **OSAS toolchain**
    - **Development**
      - Simulator (for functionality)
      - Compiler
      - Loader
    - **On-node**
      - Interpreter
  - **OSAS software components:**
    - **Services: functionalities**
    - **Subscriptions: requests for using services**
    - **Content based addresses**



# Service and Subscription

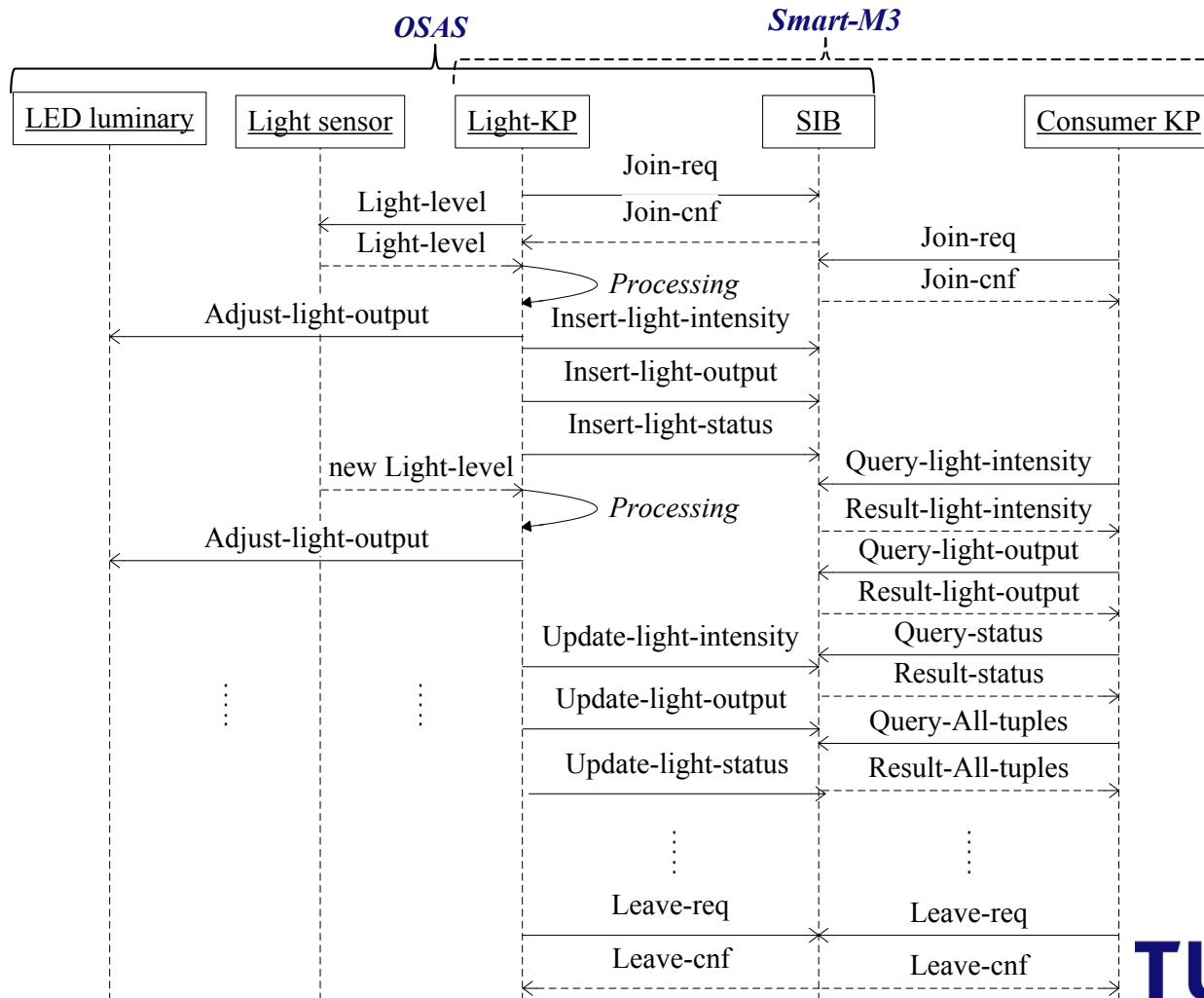


# System Architecture



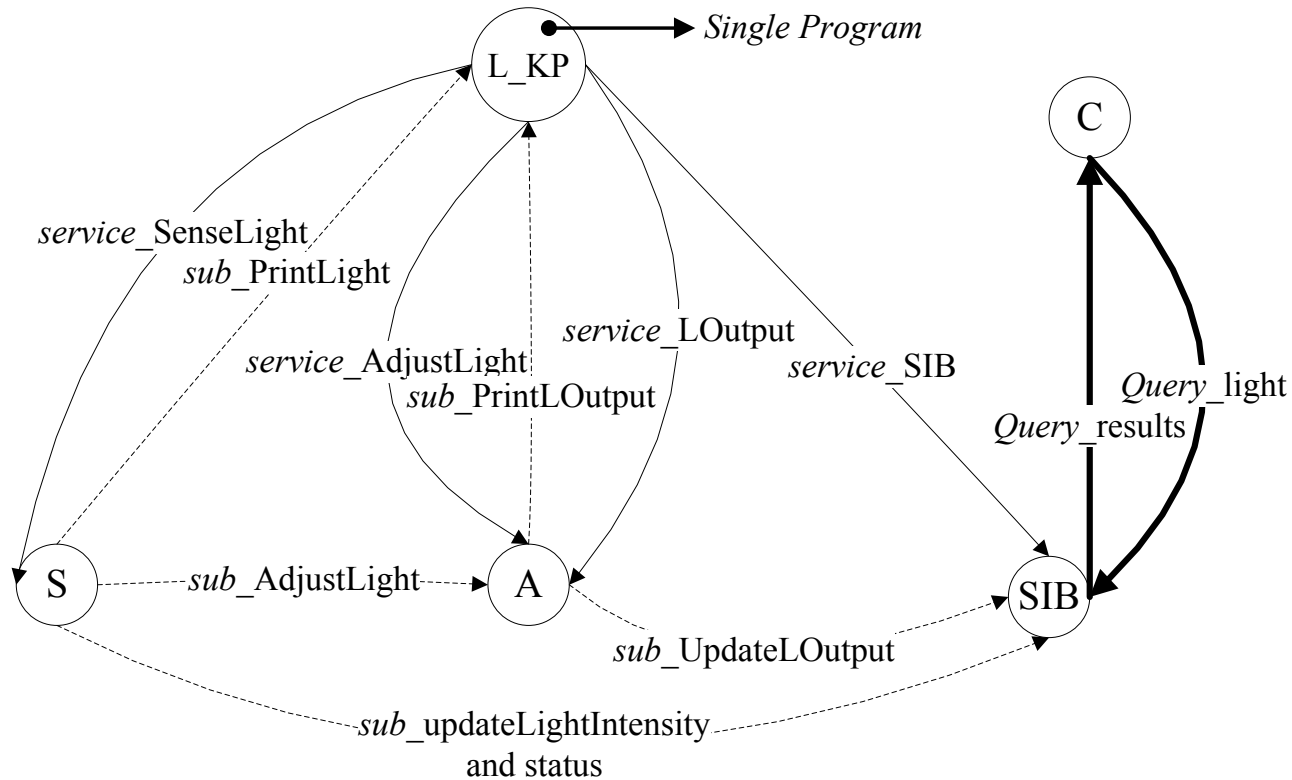
- **Low capacity devices: sensor node, actuator, etc.**
- **High capacity devices: cell phone, PDA, netbook, etc.**

# Sensor and Actuator Interaction with KP





# Services and Subscription for HSLs



L\_KP: loader node (light-KP)

S : light sensing node

A : LED actuator node

SIB : SIB node

C : consumer-KP node

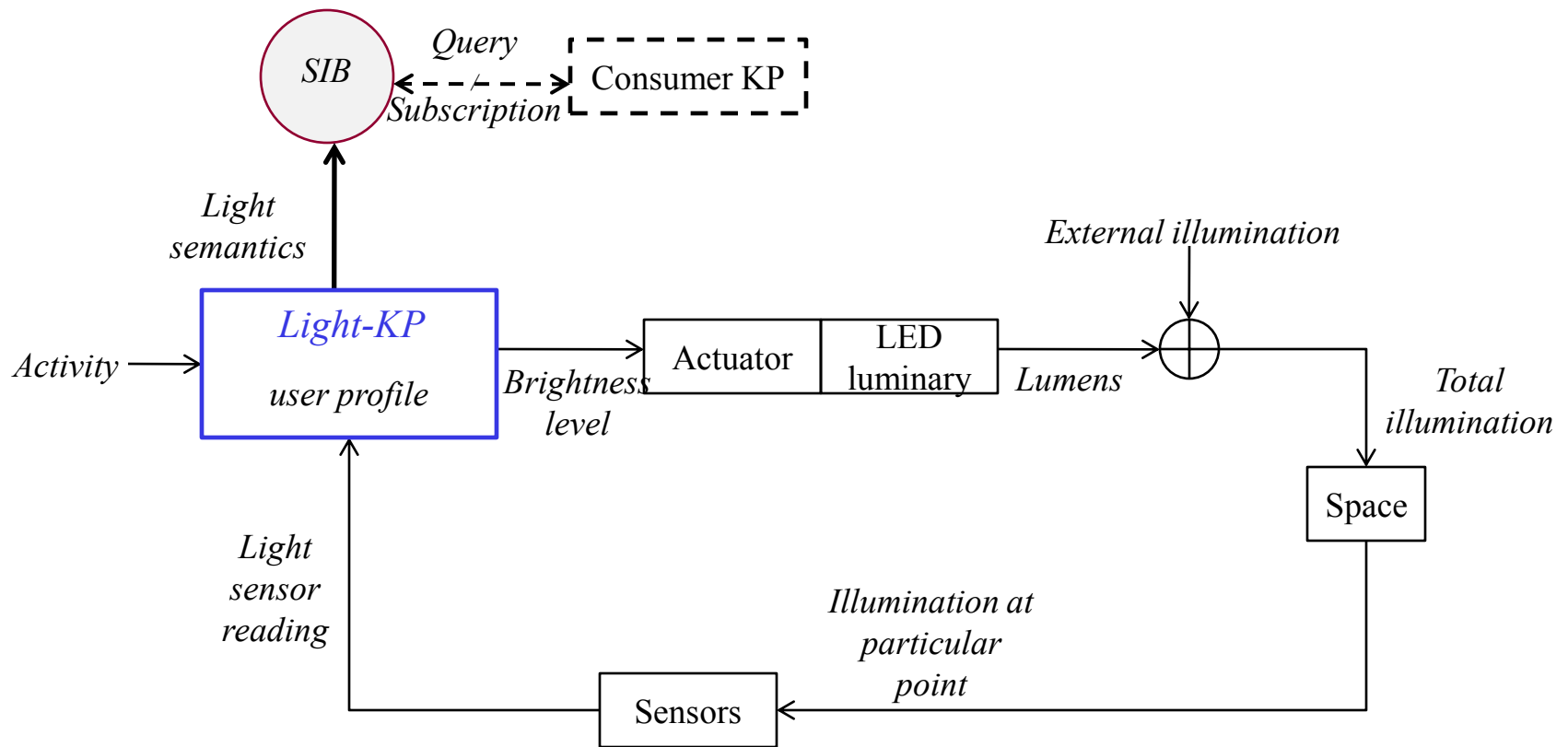
—————> *services installed*

- - - - -> *Event flow of subscription made*

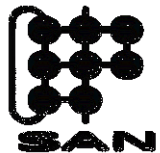
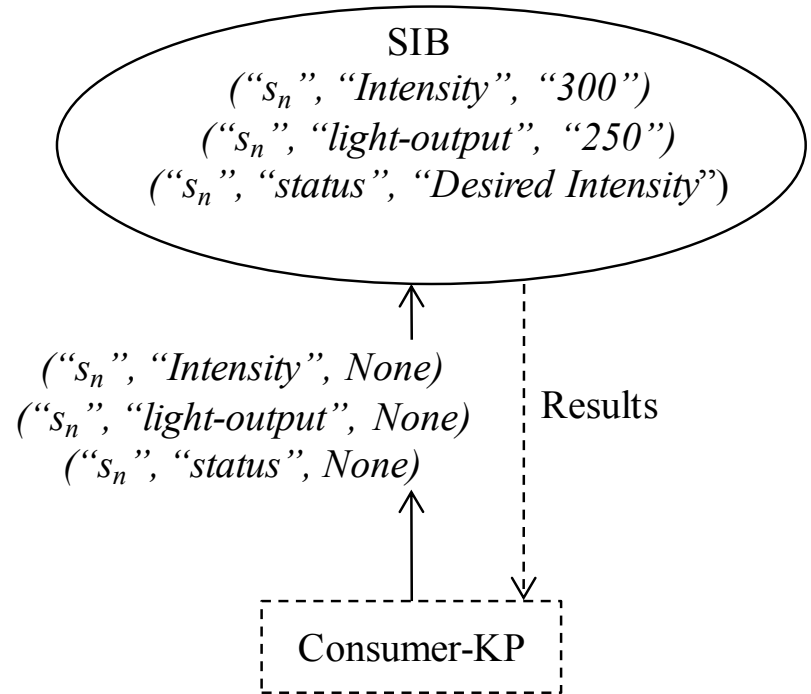
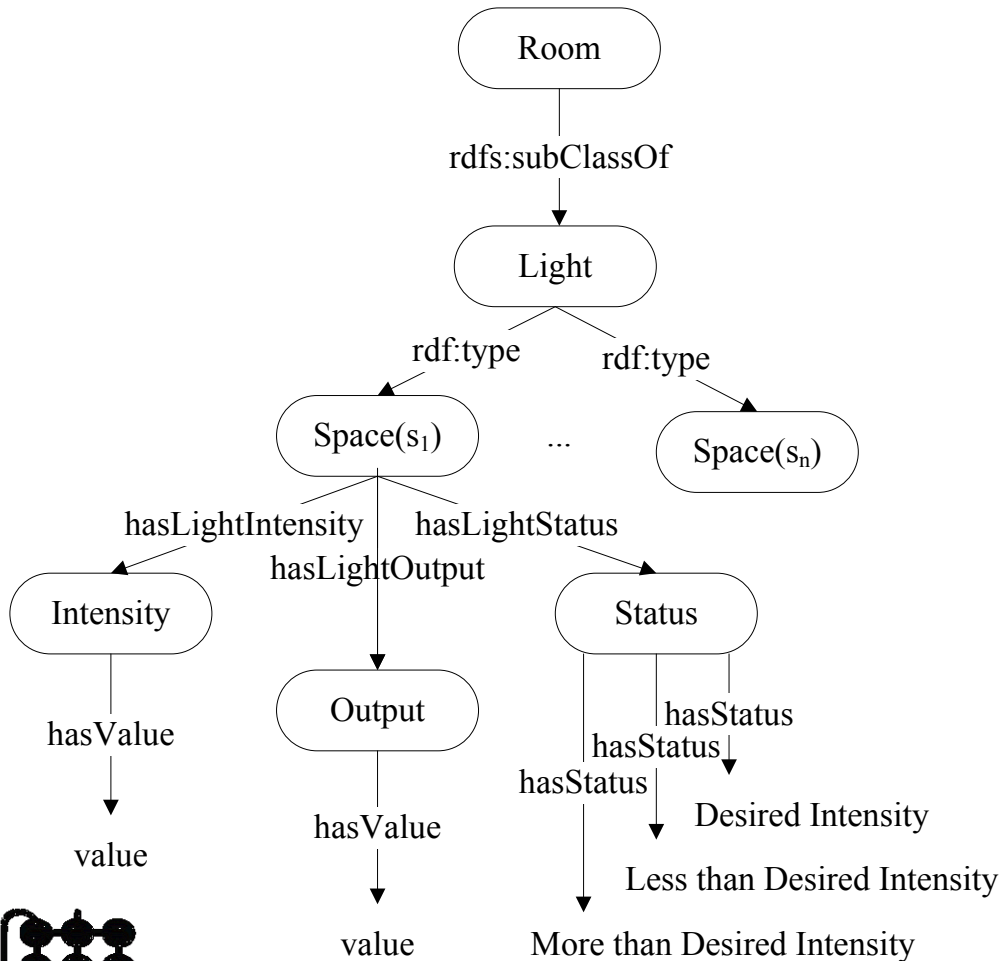
—————> *query*



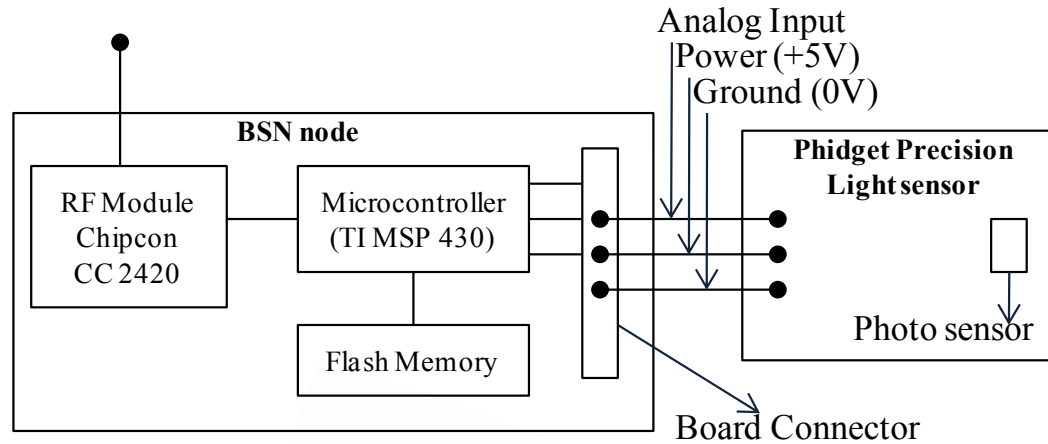
# Control flow of Light Model



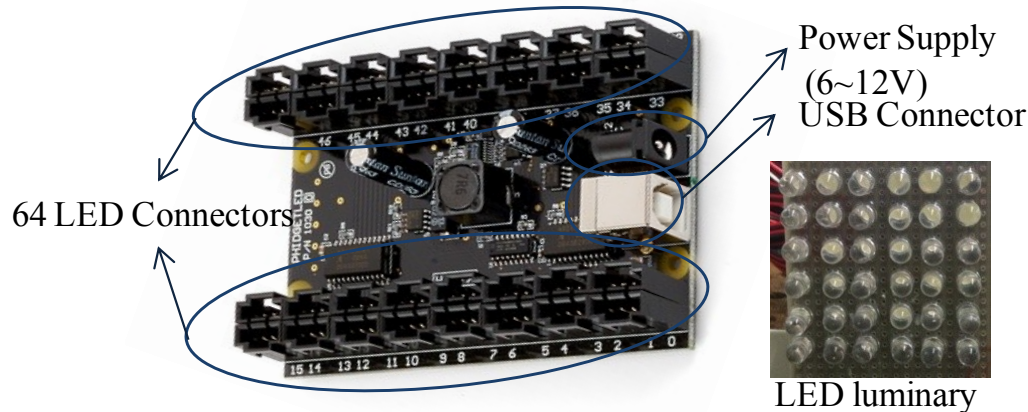
# RDF Schema of Light Information and Query Sample



# Experimental Devices



(a) Light sensor node

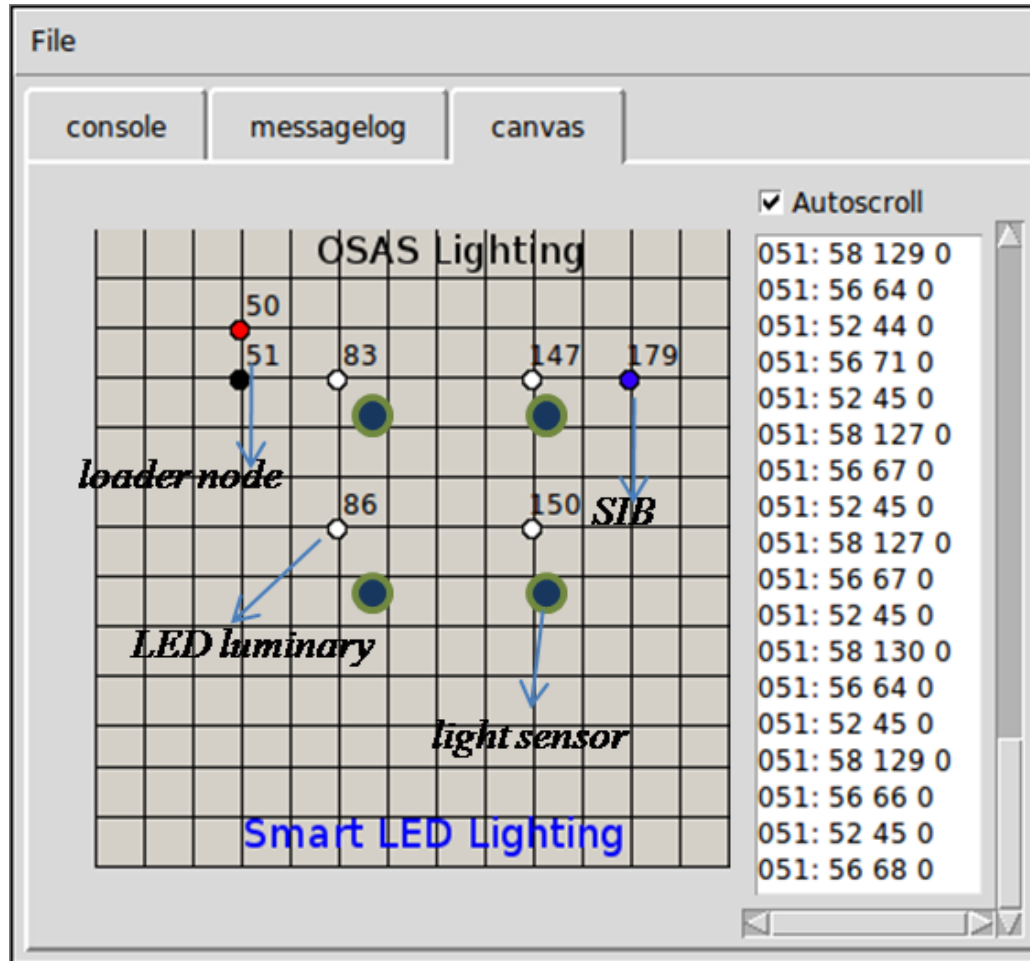


64-PhidgetLED Board

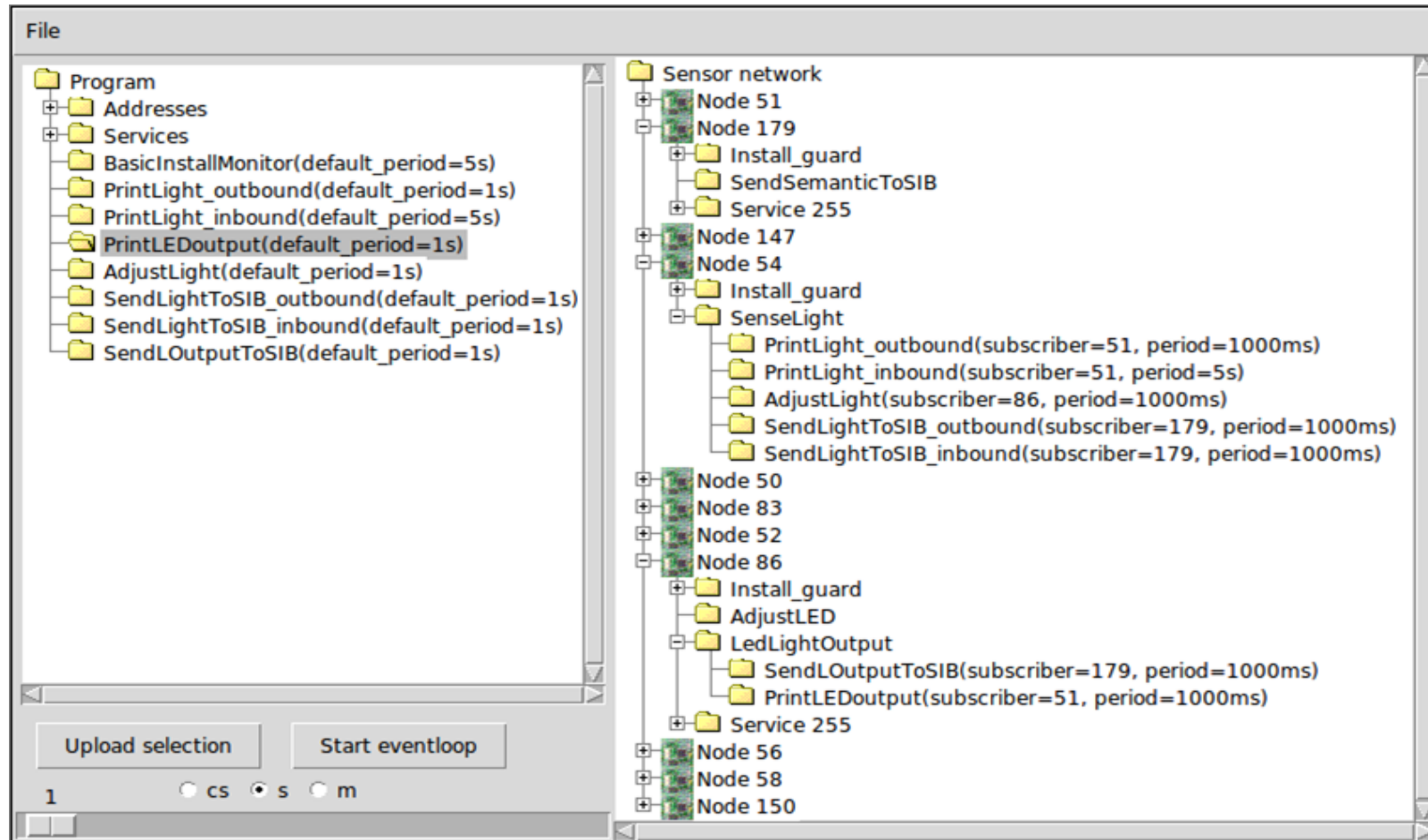
(b)

(c)

# Experimental Results: Simulator GUI



# Experimental Results: Loader GUI



# Experimental Results: Consumer KP

Query to SIB			
Status of Lighting Environment			
Space 1	Space 2	Space 3	Space 4
All Spaces			
Light Intensity (lux)			
Space 1	Space 2	Space 3	Space 4
All Spaces			
Light Output (lumens)			
Space 1	Space 2	Space 3	Space 4
All Spaces			
List All Triples at SIB			
All Triples			
Results of Queries			
((u's3', u'status', u'More than Desired Intensity'), True)			
((u's1', u'status', u'More than Desired Intensity'), True)			
((u's2', u'status', u'More than Desired Intensity'), True)			
((u's4', u'status', u'More than Desired Intensity'), True)			
((u's3', u'intensity', u'703'), True)			
((u's1', u'intensity', u'779'), True)			
((u's4', u'intensity', u'682'), True)			
((u's2', u'intensity', u'875'), True)			
Quit			



# Conclusions

- Proposed a heterogeneous smart lighting system approach for *distributed LED luminary* control and an *light model* based on user preferences.
- The light model guarantees that the *desired illumination* levels of *user preferences* are achieved.
- *Interoperability* between low and high capacity nodes from OSAS and Smart-M3 platforms, respectively.





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**Thank you for your kind attention !**

